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MCAS EL TORO
SSIC NO. 5090.3

Comprehensive Long-Term Environmental Action Navy (CLEAN) II
Contract No. N62742-94-D-0048
Contract Task Order No. 0078

Final Work Plan

Removal Site Evaluation Anomaly Area 3

Former Marine Corps Air Station, El Toro, California

Prepared for:

Department of the Navy
Commander, Southwest Division
Naval Facilities Engineering Command
San Diego, California 92132-5190

August 2002

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Prepared by

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August 2002

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DOCUMENT TRANSMITTAL

Contract No. N62742-94-D-0048

To: Remedial Project Manager
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DATE: August 30, 2002
CTO #: 078
LOCATION: MCAS, El Toro

FROM: Crispin G. Wanyoike ~~cfg Carr~~, For

DESCRIPTION: Final Work Plan and Health and Safety Plan, Removal Site Evaluation, Anomaly Area 3, Former Marine Corps Air Station (MCAS) El Toro, California

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Final Work Plan
Removal Site Evaluation
Anomaly Area 3
Former MCAS El Toro, California

Contract No. N62742-94-D-0048
Contract Task Order No. 0078

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APPENDIXES

FIGURES

TABLES

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ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µmhos	micro mhos
Air SWAT	air quality solid waste assessment test
AM	action memorandum
APHO	aerial photograph
ASTM	American Society of Testing and Materials
BCT	BRAC Cleanup Team
BERA	baseline ecological risk assessment
bgs	below ground surface
BNI	Bechtel National, Inc.
BRAC	Base Realignment and Closure
CAD	computer-aided design
Cal-EPA	California Environmental Protection Agency
CARB	California Air Resources Board
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
COPC	chemical of potential concern
CPT	cone penetrometer test
CRWQCB	California Regional Water Quality Control Board
CSM	conceptual site model
CTO	contract task order
DHS	California Department of Health Services
DoN	Department of the Navy
DoT	California Department of Transportation
DQOs	data quality objectives
DTSC	Department of Toxic Substances Control
Earth Tech	Earth Tech, Inc.
EE/CA	Engineering Evaluation/Cost Analysis
ECR	excess cancer risk
EM	Electromagnetic
EM-31	Geonics EM-31 terrain conductivity meter
EPA	Environmental Protection Agency
EPC	exposure point concentration
EWI	Environmental Work Instructions
FFA	Federal Facilities Agreement
FS	feasibility study
FSP	field sampling plan
HI	hazard index
HPCDF	heptachlorodibenzofuran
HXCDD	hexachlorodibenzodioxin
HPCDF	Heptachlorodibenzofuran
HXCDD	hexachlorodibenzodioxin
HXCDF	hexachlorodibenzofuran
IDW	investigation-derived waste

IRA	Interim Removal Action
IRCDQM	*Navy Installation Restoration Chemical Data Quality Manual*
IRP	Installation Restoration Program
LEL	lower explosive limit
Max	maximum
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
MSC R	miscellaneous refuse
MSD	matrix spike duplicate
MSL	mean sea level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ng/L	nanograms per liter
NPL	National Priorities List
nT	nanoteslas
OCDD	octachlorodibenzodioxin
OCDF	octachlorodibenzofuran
OSWER	EPA Office of Solid Waste and Emergency Response
PACNAVFACENGCOM	Pacific Division, Naval Facilities Engineering Command
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PeCDD	pentachlorodibenzodioxin
PeCDF	pentachlorodibenzofuran
pg/g	picograms per gram
ppmv	parts per million by volume
PRE	preliminary risk evaluation
PRG	preliminary remediation goal
PVC	polyvinyl chloride
QAPP	quality assurance project plan
RAGS	Risk Assessment Guidance for Superfund
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
RSE	removal site evaluation
SAIC	Science Applications International Corporation
SARA	Superfund Amendments and Reauthorization Act
SCAQMD	South Coast Air Quality Management District
SERA	screening ecological risk assessment
SMDP	scientific management decision point
SSL	soil screening levels
SVOC	semivolatile organic compound
SWDIV	Naval Facilities Engineering Command, Southwest Division
TCDD	tetrachlorodibenzodioxin
TCDF	tetrachlorodibenzofuran
TEF	toxicity equivalency factor
TEQ	toxicity equivalent quotient
TOC	top of casing
TPH	total petroleum hydrocarbons
U.S.	United States
UCL	upper 95th percentile confidence limit
VOC	volatile organic compound
WHO	World Health Organization

1. INTRODUCTION

This work plan details the objectives and procedures for the collection of data to support the Removal Site Evaluation (RSE) for Anomaly Area 3 at the former Marine Corps Air Station (MCAS), El Toro, California.

This work plan was prepared by Earth Tech, Inc. (Earth Tech) on behalf of the United States (U.S.) Department of the Navy (DoN), Southwest Division, Naval Facilities Engineering Command (SWDIV), as authorized by the U.S. Navy, Pacific Division, Naval Facilities Engineering Command (PACNAVFACENGCOM) under Contract Task Order (CTO) number 0078 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) II program, contract number N62742-94-D-0048.

1.1 PURPOSE AND SCOPE OF WORK

The purpose of the RSE is to collect data necessary for preparation of the removal action documentation for Anomaly Area 3. The scope of this work plan includes the following:

- Collection of soil vapor, soil, groundwater, and surface water and sediment samples to evaluate the impact, if any, due to waste placement;
- Confirmation of the lateral limits of the waste placement;
- Evaluation of human health and ecological risk;
- Collection of soil samples to conduct a geotechnical assessment of the existing soil cover and provide data for the design of a cover system, if required.

This work plan includes the elements of a sampling and analysis plan, namely the field sampling plan (FSP) and a quality assurance project plan (QAPP) as recommended in the Environmental Protection Agency (EPA) document, *Requirements for Quality Assurance Project Plans for Environmental Data Operations, QA/R-5* (EPA 1997a).

The work plan complies with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 of the Code of Federal Regulations (CFR), Part 300, and the California Health and Safety Code, Section 6.8.

1.2 FORMER MCAS EL TORO DESCRIPTION AND BACKGROUND

Former MCAS El Toro is located in a semi-urban, agricultural area of southern California, approximately 8 miles southeast of Santa Ana and 12 miles northeast of Laguna Beach (Figure 1-1). MCAS El Toro covers approximately 4,738 acres. Land use around MCAS includes commercial, light industrial, and residential. MCAS El Toro closed on 2 July 1999, as part of the Base Realignment and Closure (BRAC) Act.

The DoN conducted an *Initial Assessment Study* at MCAS El Toro in 1985 (Brown and Caldwell 1986) and a *Site Inspection Plan of Action* during 1987 and 1988 (James M. Montgomery Engineers, Inc. 1988).

MCAS El Toro was added to the National Priorities List (NPL) of the Superfund Program on 15 February 1990 due to volatile organic compound (VOC) contamination at the former MCAS boundary and in the agricultural wells west of former MCAS El Toro. A Federal Facilities Agreement (FFA) was signed by the Marine Corps and the DoN in October 1990 with the EPA Region 9, California Department of Health Services (DHS) (part of which is currently the Department of Toxic Substances Control [DTSC]), and the California Regional Water Quality Control Board, Santa Ana Region (CRWQCB).

In March 1993, MCAS El Toro was placed on the list of military facilities scheduled for closure under the BRAC Act. A BRAC Cleanup Team (BCT), including representatives from SWDIV, EPA, DTSC, and CRWQCB, was formed to oversee implementation of the FFA.

Implementation of the FFA at former MCAS El Toro included the following investigations and studies at various sites: an air quality solid waste assessment test (Air SWAT), a Phase I remedial investigation (RI), a Phase II RI, and a feasibility study (FS). The DoN conducts stationwide groundwater sampling routinely.

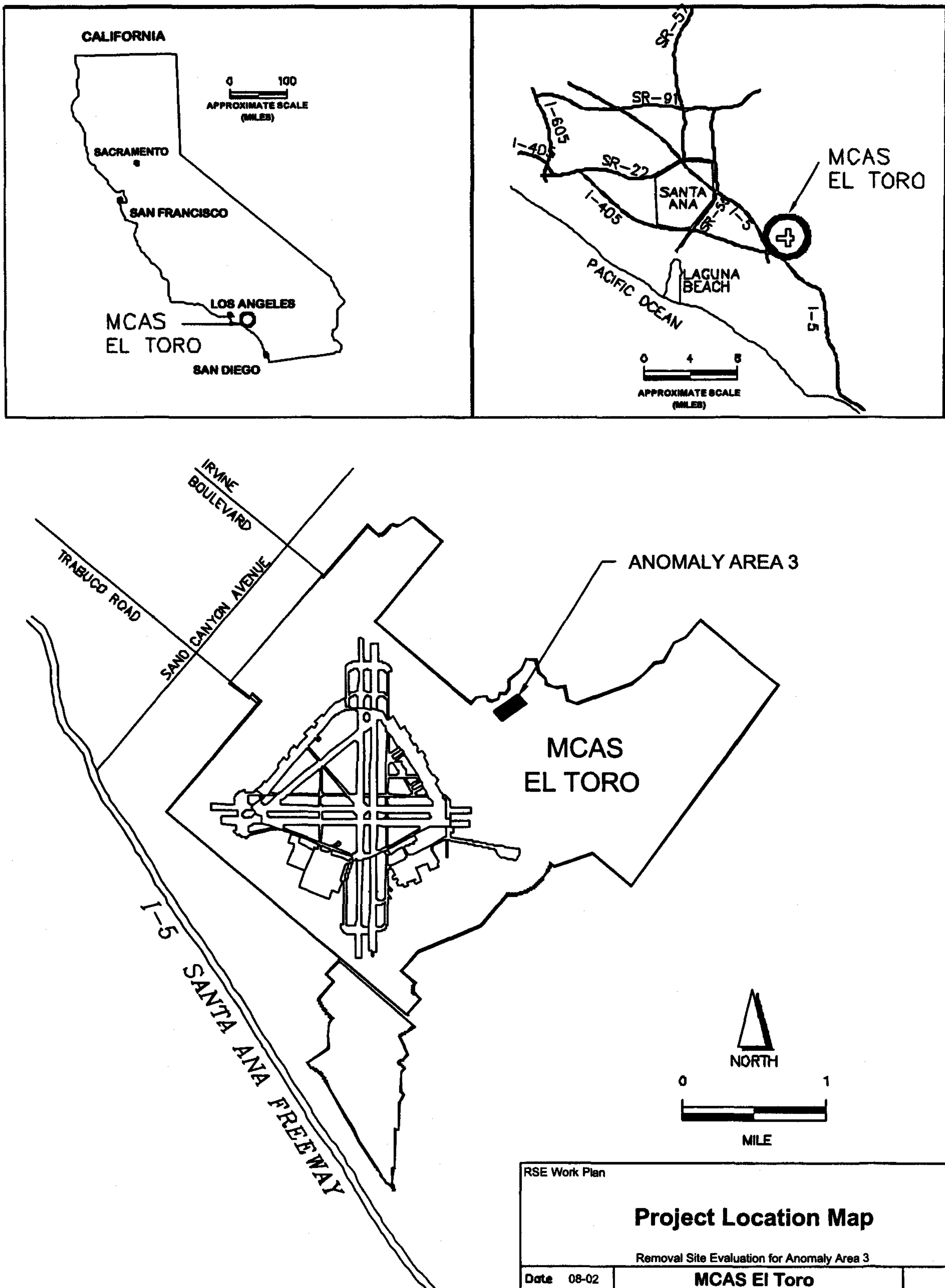
1.3 Guidance and Agreements

Consistent with the intent of the FFA, the DoN has consulted with members of the BCT regarding implementation of assessment and response actions at Anomaly Area 3.

After consultation, and with the approval of regulatory agencies, the assessment and development of response actions for Anomaly Area 3 will be administratively handled as part of Installation Restoration Program (IRP) Site 3. This will facilitate and expedite implementation of these actions and will allow quicker transfer of the property. The DoN anticipates that an Interim Removal Action (IRA) will be required for Anomaly Area 3. As part of the administrative record documentation, an engineering evaluation/cost analysis (EE/CA) will be prepared and an Action Memorandum (AM) issued prior to implementing the removal action. The record of decision (ROD) for IRP Site 3 will be revised to include mention of the anticipated IRA at Anomaly Area 3 and issued as interim final. The final version of the IRP Site 3 ROD will be issued following the implementation of the IRA and regulatory approval of the removal action report.

In addition, investigation and response actions will be conducted in accordance with the following guidance:

- *Final Work Plan Phase II Remedial Investigation/Feasibility Study*, MCAS El Toro (BNI 1995)
- *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (EPA 1991)
- *Presumptive Remedy for CERCLA Municipal Landfill Sites* (EPA 1993)
- *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills* (EPA 1996)



RSE Work Plan Final

Project Location Map

Removal Site Evaluation for Anomaly Area 3

Date 08-02	**MCAS El Toro**	Figure
Project No. 37380	EARTH TECH A tyco INTERNATIONAL LTD. COMPANY	1-1

2. SITE BACKGROUND AND SETTING

2.1 LOCATION

Anomaly Area 3 encompasses an area of approximately 9 acres and is located in the northwestern section of the former MCAS El Toro facility near Pusan Way, adjacent to the Agua Chinon Wash (Figure 2-1). Anomaly Area 3 has also been designated as miscellaneous refuse (MSC R) 1, a "former refuse disposal area" in the *BRAC Business Plan* update (DoN 2000).

Miscellaneous refuse Anomaly Area 3 refers to seven aerial photograph (APHO) anomaly areas (APHO 59, APHO 60, APHO 61, APHO 62, APHO 63, APHO 64, and APHO 65) identified by Science Applications International Corporation (SAIC) during a review of historical aerial photographs taken during the period from 1946 through 1992 (SAIC 1993).

- In the SAIC 1946 photograph, Anomaly Area 3 was referred to as APHO 59 (identified as SAIC 20), an area encompassing three areas of apparent extraction;
- In the SAIC 1946 and 1960 photographs, Anomaly Area 3 was referred to as APHO 60 and APHO 61 (identified as SAIC 64 and SAIC 106, respectively) which were quarried extraction areas;
- In the SAIC 1976 photograph, Anomaly Area 3 was referred to as APHO 62 (identified as SAIC 156), an area of extraction near Agua Chinon Wash with possible refuse or liquid within the excavated area;
- In the SAIC 1981 photograph, Anomaly Area 3 was referred to as APHO 63 (identified as SAIC 43), an area of extraction near Agua Chinon Wash that has been revegetated;
- In the SAIC 1988 photograph, Anomaly Area 3 was referred to as APHO 64 (identified as SAIC 36), a former extraction area near Agua Chinon Wash that has been filled;
- In the SAIC 1992 photograph, Anomaly Area 3 was referred to as APHO 65 (identified as SAIC 564), a graded area.

2.2 LAND USE

Historically, the site was used as a source of borrow material. Records indicate that some of the borrow pits and trenches were backfilled with construction debris and later covered with 5 feet or more of fill soil (IT/OHM 2000). Based on a review of historical aerial photographs and topographic maps, placement of construction debris occurred between 1972 and 1988. Interviews with former station personnel indicate that construction debris generated during the construction of the investigation-derived waste (IDW) management area at IRP Site 3 was disposed of at Anomaly Area 3.

2.3 PREVIOUS WORK

A literature and record search was conducted during early 1999, and the BCT conducted a site visit and visual inspection of the area during August 1999. IT/OHM was contracted to install monitoring wells and vadose zone wells, conduct a geophysical investigation of the area, advance exploratory trenches at the site, and conduct a radiological screening survey during exploratory trenching. A technical information package presenting the data collected (IT/OHM 2000) was submitted to the BCT.

During October 1999, four monitoring wells were installed at the site (MW1, MW2, MW3, and MW4) to evaluate the groundwater elevations and flow direction at the site (Figure 2-2). Three vadose zone wells were also installed (PZ1, PZ2, and PZ3; Figure 2-2). The *Technical Information Package* (IT/OHM 2000) refers to these monitoring and vadose zone wells with "MSCR1" preceding the well numbers; however, this prefix has been dropped in this work plan. Sampling was conducted for soil, groundwater; and soil vapor components; and data validation for the analytical results was performed in May 2000. A geophysical investigation was conducted by IT/OHM on February 9 through 18, 2000, to screen the site for buried metallic debris and fill soils.

Limited exploratory trenching was also conducted during March 2000, which generally confirmed the results of the geophysical survey. Eighteen trenches/pits (1E to 7E, H1 to H9 and 9E and H2, each of which consist of two trenches each) were excavated at the site. Radiological screening was conducted as a part of the trenching (Figure 2-3) (Weston 2000).

2.4 Environmental Setting

2.4.1 Geology

Regional Geology. Former MCAS El Toro lies on the southeastern edge of the Tustin Plain, a gently sloping surface of alluvial fan deposits derived mainly from the Santa Ana Mountains. Silts and clays predominate in the central and northwestern portion of former MCAS El Toro, and sands predominate in areas near the foothills. Sandstone and siltstone bedrock outcrops in the foothills. The sands are generally well-graded and commonly contain clay lenses.

Site Geology. Based upon a review of drilling logs provided in the *Anomaly Area 3 Technical Information Package* (IT/OHM 2000), subsurface stratigraphy in this area consists of fine-to-coarse-grained sediments overlying bedrock (sandstone, siltstone, and claystone). Unconsolidated sediments were identified as well-graded gravel, gravelly sand, well-graded and poorly graded sand, silty sand, and clayey sand. Sediments were generally brown, yellowish brown, olive-brown, and greyish brown, with local iron staining.

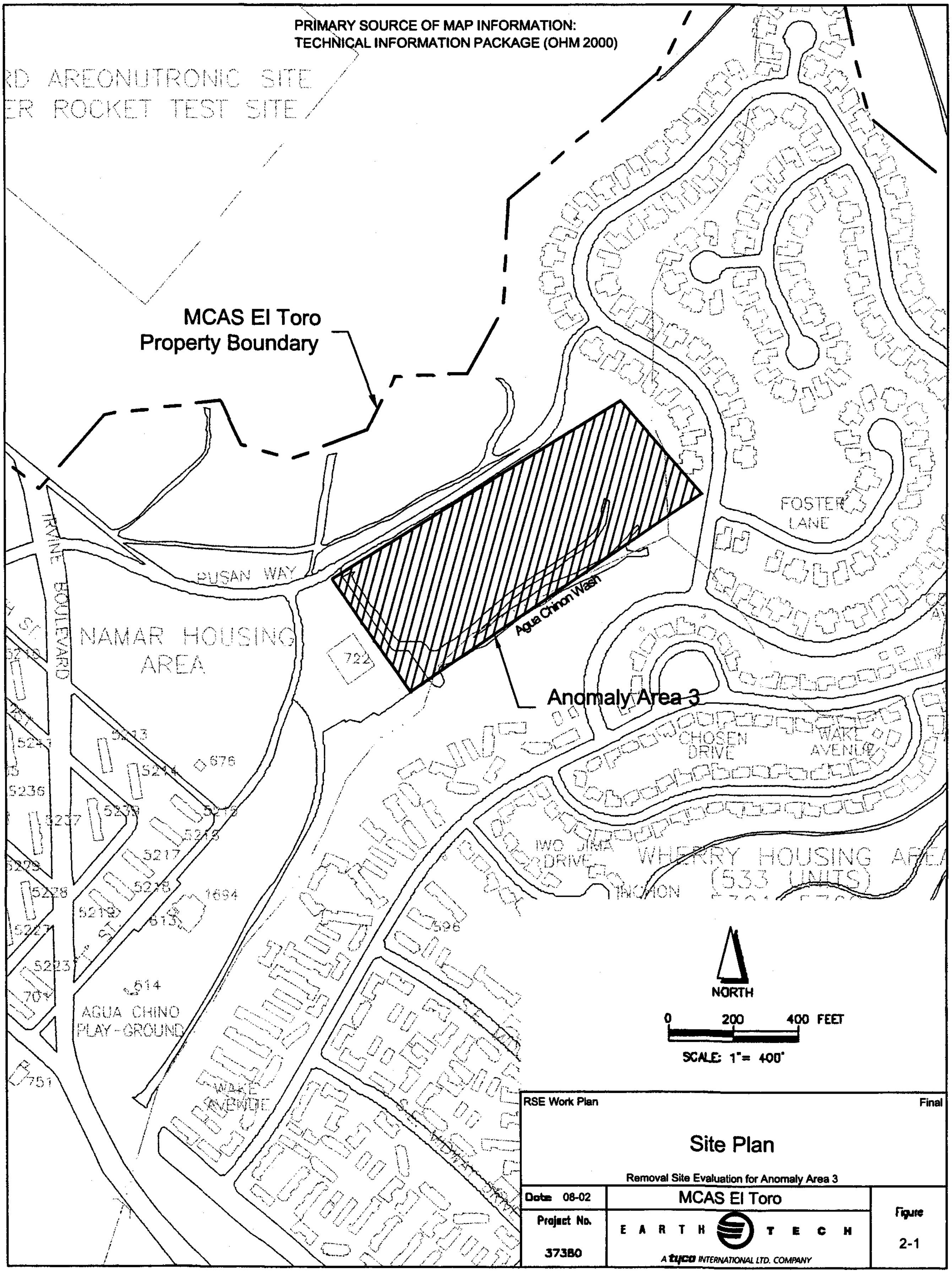
Figures 2-4 and 2-5 show geologic cross-sections of the site. As can be seen on the figures, bedrock was encountered at approximately 15 feet below ground surface (bgs) in MW3, 25 feet bgs in MW4, 46 feet bgs in MW1, and approximately 51 feet bgs in MW2. Bedrock was not encountered in PZ1, PZ2, or PZ3. (PZ1, PZ2, and PZ3 were drilled to total depths of 22 feet, 30 feet, and 26 feet bgs, respectively). The depth to bedrock increases toward the southwest.

The drilling logs for the four monitoring wells identify the bedrock as Pliocene Niguel Formation. Sandstone is generally light to dark gray and light olive-brown with yellowish mottling, with very fine- to medium-grained sand, poorly indurated, and dense to very dense. Siltstone bedrock is generally light brown, olive, or gray with local yellowish mottling and described as hard and stiff. Claystone bedrock is generally brown to olive to very dark gray and described as hard and very stiff.

2.4.2 Hydrogeology

Regional Hydrogeology. Former MCAS El Toro is located within the Irvine Groundwater Forebay, which has been designated by the CRWQCB as a public water supply source (CRWQCB 1995). The aquifer located directly beneath former MCAS El Toro is not currently used for municipal water supply; however, groundwater near the station is used for agricultural purposes.

Site Hydrogeology. Groundwater level measurements from wells MW1, MW2, and MW3 were conducted on 14 February and 9 August 2001. Depth to water in these wells ranged from 21.76 feet



RSE Work Plan		Final
	Site Plan	
	Removal Site Evaluation for Anomaly Area 3	
Date 08-02	MCAS El Toro	Figure
Project No. 37380	EARTH TECH A tyco INTERNATIONAL LTD. COMPANY	2-1

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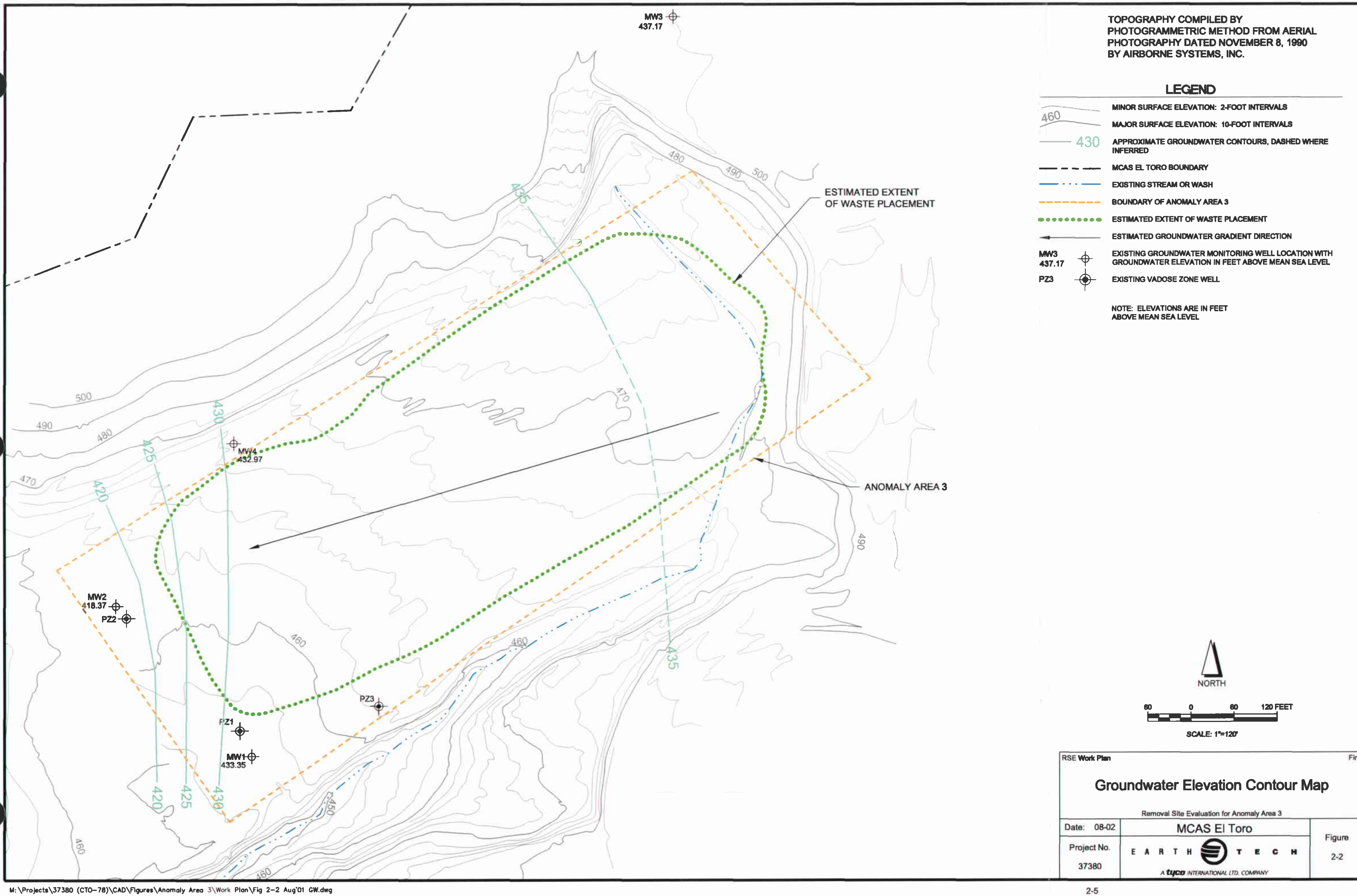
TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHOD FROM AERIAL PHOTOGRAPHY DATED NOVEMBER 8, 1990 BY AIRBORNE SYSTEMS, INC.
LEGEND
MINOR SURFACE ELEVATION: 2-FOOT INTERVALS
460
MAJOR SURFACE ELEVATION: 10-FOOT INTERVALS
430
APPROXIMATE GROUNDWATER CONTOURS, DASHED WHERE INFERRED
MCAS EL TORO BOUNDARY
EXISTING STREAM OR WASH
BOUNDARY OF ANOMALY AREA 3
ESTIMATED EXTENT OF WASTE PLACEMENT
ESTIMATED GROUNDWATER GRADIENT DIRECTION
MW3
437.17
EXISTING GROUNDWATER MONITORING WELL LOCATION WITH GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
PZ3
EXISTING VADOSE ZONE WELL
NOTE: ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL
ESTIMATED EXTENT OF WASTE PLACEMENT
ANOMALY AREA 3
MW3
437.17
MW4
432.97
MW2
418.37
PZ2
PZ3
PZ1
MW1
433.35
500
490
480
470
460
450
435
430
425
420
NORTH
60
0
60
120 FEET
SCALE: 1"=120'
RSE Work Plan
Final
Groundwater Elevation Contour Map
Removal Site Evaluation for Anomaly Area 3
Date: 08-02
MCAS El Toro
Project No.
37380
EARTH TECH
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Figure
2-2
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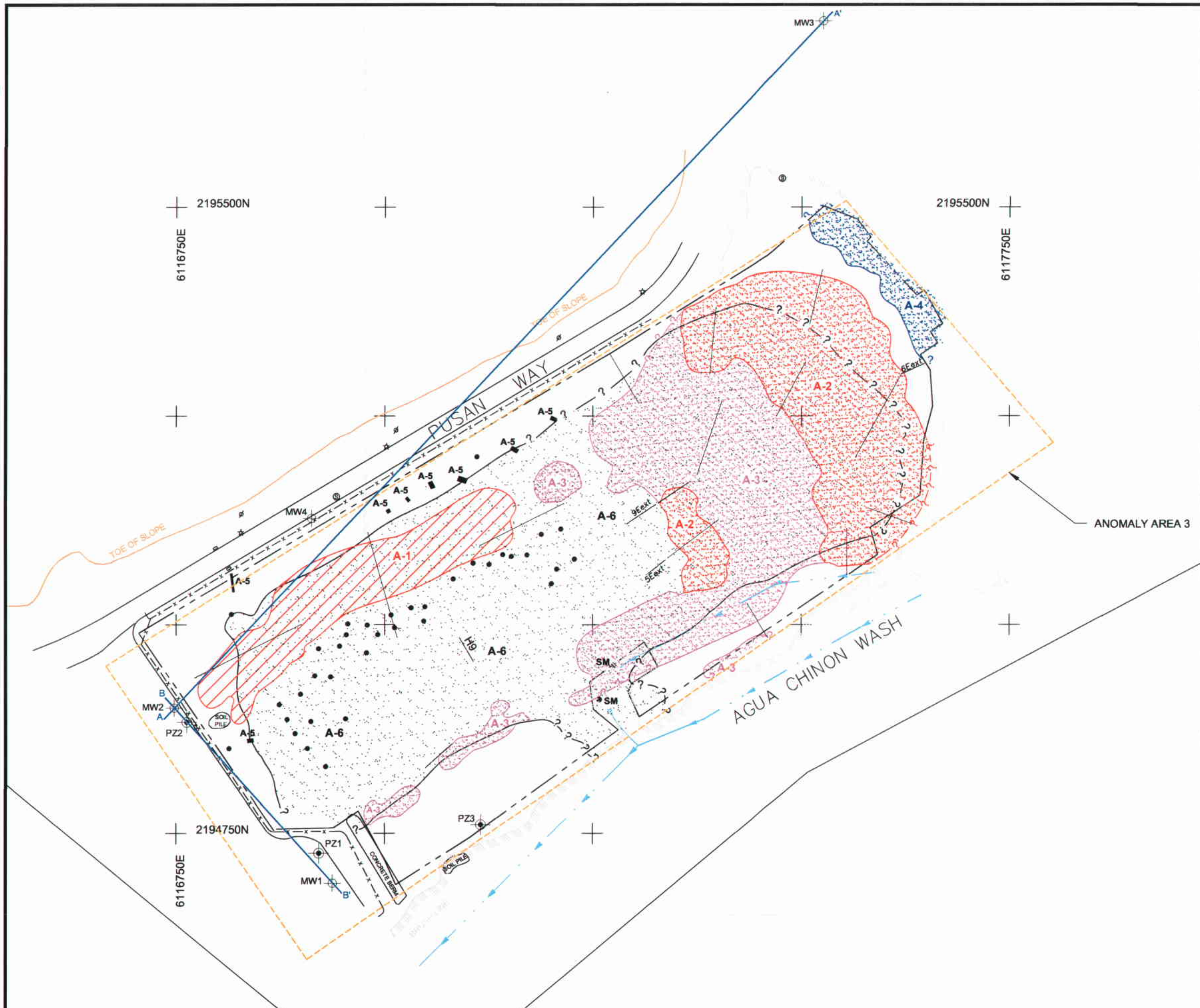

PRIMARY SOURCE OF INFORMATION:
TECHNICAL INFORMATION PACKAGE (OHM 2000)

LEGEND

- BOUNDARY OF GEOPHYSICAL SURVEY AREA
- BOUNDARY OF ANOMALY AREA 3
- X — CHAIN-LINK FENCE
- AGUA CHINON WASH
- Ⓢ SEWER MANHOLE
- ☆ LIGHT POLE
- Ø POWER POLE
- STORM DRAIN
- MW2 GROUNDWATER MONITORING WELL
- PZ2 VADOSE ZONE WELL
- SM ● SURFACE METALLIC OBJECT/DEBRIS
- ● VERY SMALL BURIED METALLIC OBJECT/DEBRIS
- A — A' CROSS SECTION LOCATION
- A-1 LARGE TRENCH CONTAINING HIGH CONCENTRATION OF DEEP BURIED METALLIC/CONSTRUCTION DEBRIS
- A-2 DISPOSAL AREA CONTAINING HIGH CONCENTRATION OF DEEP BURIED METALLIC/CONSTRUCTION DEBRIS
- A-3 DISPOSAL AREA CONTAINING SCATTERED DEEP BURIED METALLIC/CONSTRUCTION DEBRIS
- A-4 AREA CONTAINING SHALLOW BURIED METALLIC/ CONSTRUCTION DEBRIS
- A-5 LARGE BURIED METALLIC OBJECT OR SMALL ACCUMULATION OF BURIED METALLIC DEBRIS
- A-6 AREA CONTAINING POSSIBLE IMPORTED FILL
- 5E TRENCH LOCATIONS
- H4 TRENCH/POTHOLE LOCATIONS
- — ? — LINE INDICATES UNCERTAIN BOUNDARY

NOTES:

1. COORDINATES ARE IN CALIFORNIA STATE PLANE COORDINATE SYSTEM, NAD83, ZONE 6.
2. INTERPRETED BOUNDARIES ARE APPROXIMATE, QUERIED WHERE INFERRED OR UNCERTAIN.

NORTH

60 0 60 120 FEET

SCALE: 1"=120'

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Geophysical Anomalies and Previous Trench/Pothole Locations

Removal Site Evaluation for Anomaly Area 3

Date: 08-02	MCAS El Toro	Figure
Project No. 37380	EARTH TECH A tyco INTERNATIONAL LTD. COMPANY	2-3

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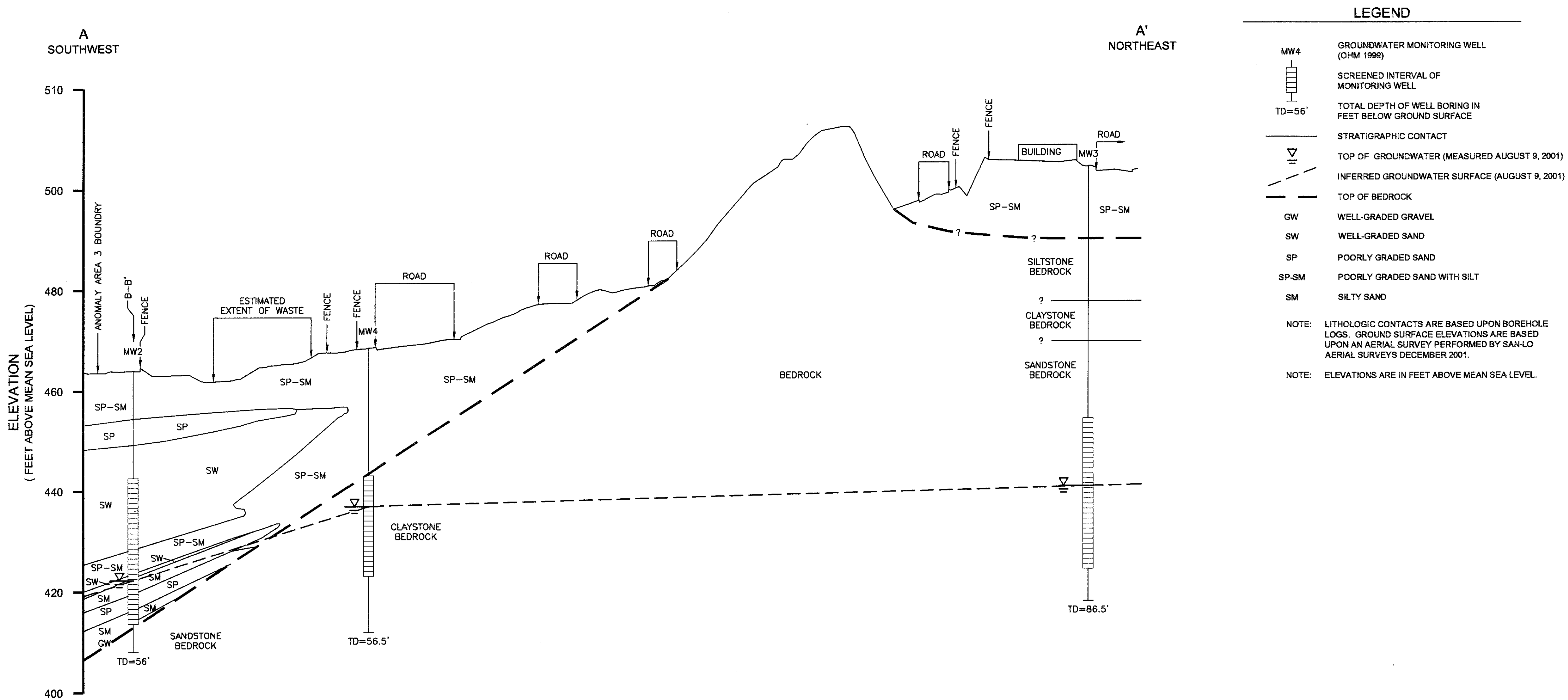

RSE Work Plan | Final

Geologic Cross Section A-A'

Removal Site Evaluation for Anomaly Area 3

Date: 08-02	Former MCAS El Toro	Figure
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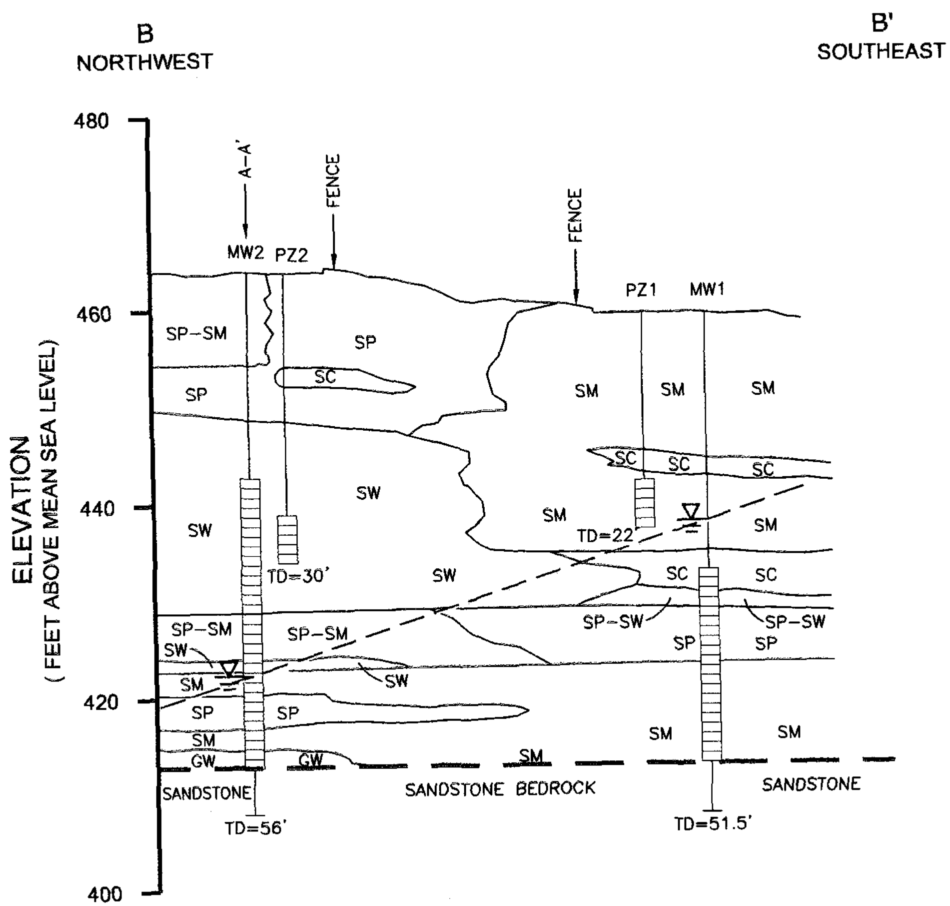

LEGEND

MW2	GROUNDWATER MONITORING WELL (OHM 1999)
PZ2	VADOSE ZONE MONITORING WELL (OHM 1999)
	SCREENED INTERVAL OF MONITORING WELL
TD=56'	TOTAL DEPTH OF WELL BORING IN FEET BELOW GROUND SURFACE
	STRATIGRAPHIC CONTACT
	TOP OF GROUNDWATER (MEASURED AUGUST 9, 2001)
	INFERRED GROUNDWATER SURFACE (AUGUST 9, 2001)
	TOP OF BEDROCK
GW	WELL-GRADED GRAVEL
SW	WELL-GRADED SAND
SP-SW	POORLY TO WELL-GRADED SAND
SP	POORLY GRADED SAND
SP-SM	POORLY GRADED SAND WITH SILT
SM	SILTY SAND
SC	CLAYEY SAND

NOTE: LITHOLOGIC CONTACTS ARE BASED UPON BOREHOLE LOGS. GROUND SURFACE ELEVATIONS ARE BASED UPON AN AERIAL SURVEY PERFORMED BY SAN-LO AERIAL SURVEYS DECEMBER 2001.

NOTE: ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEAVEL.

RSE Work Plan

Final

Geologic Cross Section B-B'

Removal Site Evaluation for Anomaly Area 3

Date 08-02

Former MCAS El Toro

Project No. 37380

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Figure 2-5

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below the top of casing (TOC) in well MW1 to 63.14 feet below the TOC in well MW3. Groundwater elevations were calculated based on well casing elevations and ranged from 418.37 feet above mean sea level (MSL) in well MW2 to 437.14 feet above MSL in well MW3. The groundwater gradient direction interpreted from these data are estimated to be westerly at 2.7 percent. The gradient magnitude varies from 1.2 percent east of well MW1 to 8.0 percent west of well MW1.

The 9 August 2001 groundwater level data are consistent with previous groundwater level data for three of the four wells measured. Groundwater levels decreased in three of the four wells (MW2, MW3, and MW4) between 2.19 feet and 2.99 feet and increased 1.83 feet in well MW1 since the February 14 2001 monitoring event. Figure 2-2 shows the groundwater contours for the 9 August 2001 monitoring event.

Table 2-1 shows the groundwater level measurements from the monitoring wells for the four monitoring events. The groundwater gradients (direction and magnitude) from the February and August monitoring events are generally consistent with the gradient estimated from data collected during the previous monitoring event.

Table 2-1: Depth-to-Groundwater Measurements from the Existing Monitoring Wells

	Well ID			
Measurement Date	MW1	MW2	MW3	MW4
November 1999	23.50	39.15	60.15	28.91
December 1999	24.05	39.64	61.02	29.57
February 14, 2001	24.98	40.80	62.49	-
August 9, 2001	21.67	41.34	63.14	31.27

Notes:
All measurements are in feet below top of casing (TOC).
\- = not measured

2.5 Evaluation of Existing Data

2.5.1 Geophysical Investigation

A geophysical investigation was conducted between 9 and 18 February 2000, by IT/OHM to screen the site for buried metallic debris and fill soils. Geophysical techniques used included magnetic and electromagnetic (EM) induction methods. The magnetometers used in the investigation consisted of a Geometrics G858 cesium magnetic gradiometer and a GEM GSM-19 base station magnetometer. These instruments were used to measure the intensity of the earth's magnetic field in nanoteslas (nT). The EM induction equipment used during this investigation consisted of a Geonics EM-31 terrain conductivity meter (EM-31) coupled to a digital data logger.

The magnetic data revealed the presence of several large areas indicative of containing buried metallic debris, including a large trench in the southwest portion of the survey area (Anomaly A-1) and a large disposal area in the northeast portion of the survey area (Anomalies A-2 and A-3) (Figure 2-3). Buried debris also appeared to have accumulated at the base of the slope along the northeastern edge of the survey area (Anomaly A-4). Additionally, several buried metallic objects or small accumulations of debris (Anomaly A-5) were identified southwest of the trench (referred to as anomaly A-1), and numerous very small pieces of metallic debris were identified southeast of trench A-1. The absence of large EM-31 anomalies associated with most of the magnetic anomalies indicated that the metallic debris is deeper than 5 feet in much of the site.

The EM-31 conductivity data revealed the presence of a large area of elevated electrical conductivity in the central portion of the survey area (Anomaly A-6). This area was interpreted as containing fine-grained, clayey soils in the near surface. Because much of the native soils at the site appear to consist of low-conductivity, clean sands deposited by Agua Chinon Wash, it is likely that the conductive soils in the middle of the site are imported fill material. The surface area over which geophysical surveys were conducted encompasses 9 acres, and anomalies were identified over much of the surveyed area. Figure 2-3 shows the results of the geophysical investigation.

2.5.2 Radiological Screening Survey

The radiological screening that was conducted was categorized as an initial characterization. The screening log indicates that the radiological reading of beta/gamma and alpha were below or equal to background concentrations. A more detailed evaluation of the site will be conducted during the stationwide radiological survey.

2.5.3 Radionuclides Evaluation

Investigations previously conducted at former MCAS El Toro identified radionuclides (gross alpha and gross beta emissions) in groundwater at concentrations exceeding federal drinking water standards (Earth Tech 2001). The phase I radionuclide evaluation at the former landfill sites (Installation Restoration Program [IRP] Sites 2, 3, and 5) and the Explosive Ordnance Disposal (EOD) Range (IRP Site 1) concluded that the origin of the radionuclides in the groundwater is natural, and not anthropogenic.

An additional phase II investigation was conducted by Earth Tech in 2001 and documented in a technical memorandum (Earth Tech 2001). The study confirmed that there was no evidence that the gross alpha and gross beta emissions detected at former MCAS El Toro were caused by Marine Corps activities. The report recommended that, once the results of the ongoing radiological survey are available, the current monitoring for radionuclides be reevaluated. In addition, no further evaluation of the origin of the radionuclides in groundwater was deemed necessary.

2.5.4 Exploratory Trenching with Limited Soil Sampling

During March 2000, 18 trenches and potholes were advanced and logged by IT/OHM. Twenty-one soil samples were collected from these trenches and transported to the laboratory for analysis. Figure 2-3 shows the locations of the trenches and potholes.

A total of 18 trenches and potholes were excavated in lengths varying from 10 feet to 150 feet, with depths up to 23 feet bgs. The trench logs indicate that waste refuse was not encountered in the upper 5 feet of the trenches, providing further verification that some soil cover may have been placed and graded over the Anomaly Area 3.

Trench 1E bisected a portion of Anomaly A-1. The orientation of the trench was northwest to southeast and it was located in the southwestern portion anomaly area approximately 24 feet from the fence demarcating the boundary. The excavated material was found to consist of clays and sands. The trench had abundant quantities of concrete, rebar, and metallic debris.

Trench 2E was located in a portion of Anomaly A-2 and A-3. The orientation of the trench was southwest to northeast, and the trench was located in the northern portion of Anomaly Area 3. A strong petroleum odor was noted at 5 feet to 7 feet bgs. Construction debris was encountered from 9 feet to 22 feet bgs.

Trench 3E was located in a portion of Anomaly A-1 and south of Anomaly A-3. The orientation of the trench was northeast to southwest and it is located in the north-central portion of Anomaly

Area 3. Debris was encountered from 16 feet to 23 feet bgs. However, minor amounts of debris were encountered between 6 feet and 16 feet bgs. A single soil sample was collected from the trench at a depth of approximately 35 feet bgs.

Trench 4E was located in a portion of Anomaly A-2. The orientation of the trench was north to south, and it was located in the top northeastern portion of Anomaly Area 3 near the edges of the study area. Concrete, rebar, polyvinyl chloride (PVC), plastic bags, and heavy construction debris were encountered from 8 feet to 23 feet bgs. A strong, sweet chemical odor was noted from 3 feet to 5 feet bgs.

Trench 5E and its extension run across three portions of Anomalies A-2, A-3, and A-6. The orientation of the trench was northeast to southwest, and it was located in the central portion of Anomaly Area 3. Heavy construction debris and large granodiorite boulders were encountered 7 feet to 20 feet bgs. The extension trench had amounts of scattered debris and contained asbestos pipe.

Trench 6E and its extension were located in a portion of Anomaly A-2. The orientation of the trench was northeast to southwest, and it was located in the northeastern portion of Anomaly Area 3, near the hill located northeasterly from the site. Construction, rubble, and metal debris were encountered from 2 feet to 20 feet bgs. The northeastern extension of the trench extended to the northeasterly toe of the slope.

Trench 7E bisected a portion of Anomaly A-1. The orientation of the trench was northeast to southwest, and it was located in the lower southwestern portion of Anomaly Area 3 close to the fence demarcating the study area. A single soil pile was located near the trench. Construction debris, plastic, metal pipes, and asbestos pipes were encountered in the lower 4 feet to 22 feet bgs.

Trench 8E was located in a portion of Anomaly A-2. The orientation of the trench was north to south, and it was located in the northeastern portion of the Anomaly Area. Asphalt concrete, with thicknesses ranging from 2–3.5 inches, was located at depths of 10 feet to 12 feet bgs and was logged as a possible road or a cover.

Trench 9E bisected a portion of Anomaly A-3. The orientation of the trench was northeast to southwest, and it was located in the upper northwestern portion of the Anomaly Area 3. Construction debris, plastic, metal pipes, and asbestos pipes were encountered from 4 feet to 22 feet bgs.

Trench/Pothole H1 and its extension were located in region A-3 and was extended beyond A-3 until the limits of waste were delineated. The orientation of these trenches was east-west. The trenches were located in the lower southeastern portion of the Anomaly Area 3. Metal debris and plastic debris were encountered in the trenches.

Trench/Pothole H2 and its extension bisect regions A-3 and A-6. The orientation of these trenches was northeast-southwest. The trenches were located in the central portion of Anomaly Area 3 toward Agua Chinon wash. Concrete, wood, metal debris, and plastic were encountered in the trenches.

Trench/Pothole H3 is in region A-6. The orientation of the trench was northwest-southeast and east-west. The trench was located in the central portion of Anomaly Area 3. Some concrete debris was encountered in the trench.

Trench/Pothole H4 extends from region A-5, A-6, and A-1. The orientation of the trench was northwest-southeast and east-west. The trench was located in the central portion of Anomaly Area 3 south of Pusan Way. Construction debris and domestic refuse such as milk containers were encountered in the trench.

Trench/Pothole H5 is in region A-3. The orientation of the trench was northwest-southeast. The trench was located near the boundary of Anomaly Area 3 along Pusan Way. Construction debris including concrete rebar, metal debris, plastic, and rubber were encountered in the trench.

Trench/Pothole H6 is in region A-2. The orientation of the trench was north-south. The trench was located near the boundary of Anomaly Area 3 along Aqua Chinon Wash. Some debris was encountered in the trench.

Trench/Pothole H7 is in region A-2. The orientation of the trench was northeast-southwest. The trench was located near the boundary of Anomaly Area 3 along Aqua Chinon Wash. Some debris was encountered in the trench.

Trench/Pothole H8 is in region A-3. The orientation of the trench was northwest-southeast. The trench was located near the boundary of Anomaly Area 3 along Pusan Way. Some debris was encountered in the trench.

Trench/Pothole H9 is in region A-6. The orientation of the trench was northwest-southeast. The trench was located in the central portion of the Anomaly Area 3. Some debris was encountered in the trench.

2.5.5 Site Characterization

Soil. The 22 soil samples (plus two duplicates) that were collected from the trenches were analyzed for total petroleum hydrocarbons (TPH) (both gasoline and diesel ranges), VOCs, semivolatile organic compounds (SVOCs), metals, and mercury. Two out of the 21 soil samples were analyzed for dioxins/furans, asbestos, and perchlorate. The soil samples were collected from depths ranging from 4 feet to 22.5 feet bgs throughout the site during trenching. One-third of the soil samples analyzed were collected from depths of 4 feet to 10 feet bgs, with all remaining samples collected from greater depths. The analytes that were detected in the samples were predominantly TPH and arsenic. Lead and benzo(a)pyrene were detected in a single sample each, and both analytes had concentrations that exceeded both the background levels (Bechtel 1996) and the residential preliminary remediation goals (PRGs) (EPA 2000b). Two of 21 samples analyzed for arsenic exceeded both the background levels and the PRGs. The remaining detections of arsenic were at the background level for arsenic. Table 2-2 presents the analytes detected in soil samples collected at various depths, with trench locations shown on Figure 2-3.

Table 2-2: Trench Soil Sample Analytical Summary for Detected Analytes Exceeding Residential and Industrial PRGs

Trench number	Sample ID	Depth (feet bgs)	TPH[a] (mg/kg)	Arsenic[b] (mg/kg)	Other Analytes
1E	20242-10966	16	160	211	Lead - 677 mg/kg
	20242-1101	20	ND	6.78	-
	20242-1099	22	61	4.04	-

Table 2-2: Trench Soil Sample Analytical Summary for Detected Analytes Exceeding Residential and Industrial PRGs

Trench number	Sample ID	Depth (feet bgs)	TPH[a] (mg/kg)	Arsenic[b] (mg/kg)	Other Analytes
2E	20242-1102	4	5,600	2.12	-
	20242-1103	22	130	6.47	-
3E	20242-1110	22	63	4.92	-
	20242-1114	22	110	6.56	-
	20242-1115	35	1,100	4.82	-
4E	20242-1109	6	170	2.49	-
5E	20242-1108	10	15	3.23	-
	20242-1107	22	13	7.74	-
	20242-1117	22	220	3.25	-
	20242-1118 (dup)	22.5	130	3.05	-
6E	20242-1104	22	260	2.99	-
7E	20242-1116	22	370	2.6	-
H1	20242-1098	10	ND	3.45	-
H2	20242-1097	6	150	4.63	-
H3	20242-1095	4	ND	3.05	-
H4	20242-1112	7	42	4.59	-
	20242-1113 (dup)	7.5	79	4.35	-
H5	20242-1111	7	12	2.85	benzo(a)pyrene - 230 µg/kg
H6	20242-1106	6	ND	1.81	-
H7	20242-1105	18	150	1.85	-
H8	20242-1100	14	ND	3.98	-

Notes:
[a] Residential/Industrial PRGs not established for TPH.
[b] Concentration value of arsenic exceeding either the background levels (6.86 mg/kg) or the PRGs (residential = 0.39 mg/kg and industrial = 2.7 mg/kg) for the sample analyzed.
- = no other analytes detected.
ND = not detected
TPH = total petroleum hydrocarbons
PRGs = preliminary remediation goals
(dup) = duplicate sample
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
lead – background level at the site = 15.1 mg/kg; residential PRG concentration = 400 mg/kg; industrial PRG concentration = 1,000 mg/kg
Benzo(a)pyrene – background level at the site = 27 µg/kg; residential PRG concentration = 62 µg/kg; industrial PRG concentration = 290 µg/kg

The two soil samples (trench 4E, 6 feet; trench H3, 4 feet) that were analyzed for dioxins and furans had detected concentrations of 1,2,3,4,6,7,8-HPCDD, HPCDDs (total), HPCDFs (total), HXCDFs (total), OCDD and OCDF. Target analytes for dioxin/furan (and dioxin/furan-like compounds) are listed in the World Health Organization (WHO) list of compounds and have respective toxicity equivalency factors (TEFs) (listed in Table 2-3). The product of the analyte concentration and its associated TEF is the toxicity equivalency quotient (TEQ), which is compared with the residential and industrial soil PRGs for the dioxin 2,3,7,8-TCDD (3.9 picograms per gram (pg/g) and 27 pg/g, respectively). The calculated TEQs for samples (1.27 pg/g and 1.99 pg/g) were below the residential PRG for dioxins/furans.

Groundwater. Groundwater sampling was conducted on 4 November 1999 and 20 April 2000 at the four monitoring wells located at Anomaly Area 3 (MW1, MW2, MW3, and MW4). Wells MW1, MW2, and MW4 were installed as downgradient wells, and well MW3 was installed as an upgradient well. Figure 2-3 shows the locations of these monitoring wells. Monitoring wells MW1, MW2, MW3, and MW4 have total well depths of 51.5 feet (screen interval 16.5–46.5 feet), 56.5 feet (screen interval 21–51 feet), 86.5 feet (screen interval 50–80 feet) and 55.0 feet (screen interval 25–45 feet) bgs, respectively. Groundwater was encountered at approximately 23.5 to 62 feet bgs, and the groundwater gradient direction is northeast to southwest.

Table 2-3: Dioxin/Furan and Dioxin/Furan-Like Analyte List and Toxicity Equivalency Factors

Analyte	WHO (1997) TEFs[1]
2,3,7,8-TCDD	1
1,2,3,7,8-PCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,7,8,9-HpCDD	0.01
OCDD	0.0001
2,3,7,8-TCDF	0.1
1,2,3,7,8-PCDF	0.05
2,3,4,7,8-PCDF	0.5
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
OCDF	0.001

Note:
[1] World Health Organization (WHO) (1997) Toxicity Equivalency Factors (TEF).

A single groundwater sample was collected from each well for each sampling date (with the exception of one duplicate sample for MW1 during the 4 November 1999 sampling). The groundwater samples were analyzed for TPH, VOCs, metals, mercury, perchlorates, nitrates, lead, gross alpha and gross beta, and the following radioisotopes: uranium isotopes, radium, thorium isotopes, americium, and lead^{210}.

Table 2-4 shows the analytes that exceeded their respective maximum contaminant levels (MCLs). None of the groundwater samples had concentrations exceeding the MCLs for VOCs, metals, perchlorate, or radionuclides except as indicated in Table 2-4.

Table 2-4: Groundwater Sample Analytical Summary for Detected Analytes Exceeding MCLs

Well ID	Sample ID	Sampling Date	Total Dissolved Solids MCL = 500 mg/L (mg/L)	Manganese MCL = 50 µg/L (µg/L)	Gross Alpha MCL = 15 pCi/L (pCi/L)	Total Uranium MCL = 20 pCi/L (pCi/L)
MW1	20242-987	4 November 1999	**1,760**	**80.2**	**34.6 ± 5.27**	NA
	20242-1123	20 April 2000	NA	20 U	**27.6 ± 6.0**	**38.4**
MW2	20242-984	4 November 1999	**1,920**	**259**	**23.5 ± 4.29**	NA
	20242-1124[a]	20 April 2000	NA	43.3	**28.3 ± 6.0**	**31.63**
MW3	20242-989[b]	4 November 1999	**1,740**	20.9	**35.5 ± 5.23**	NA
	20242-1120	20 April 2000	NA	20 U	**35.7 ± 6.8**	**50.02**
MW4	20242-981	4 November 1999	**2,290**	48.1	**45.9 ± 8.5**	**56.01**
	20242-1122	20 April 2000	NA	20 U	**Greater than 15**	NA

Notes:
[a] Chromium was reported at 357 µg/L.
[b] Selenium was reported at 50.3 µg/L.
pCi/L = picoCuries per liter
µg/L = micrograms per liter
MCL = maximum contaminant level
mg/L = milligrams per liter
NA = not analyzed
Values shown in bold text are above MCLs.

Soil Gas. Three vadose zone wells were installed in October 1999. Wells PZ1, PZ2, and PZ3 have a total depths of 22 feet (screen interval 17–22 feet), 30 feet (screen interval 25–30 feet) and 26 feet bgs (screen interval 15–20 feet) respectively. Figure 2-3 shows the locations of these wells. Soil gas sampling was conducted at each of the three wells (PZ-1 through PZ-3) on 4 November 1999 and 24 July 2000. The samples were analyzed for VOCs and fixed gases (carbon dioxide, carbon monoxide, methane, nitrogen, and oxygen). Methane was not detected in any of the samples; all VOCs that were detected were at concentrations below 1 micrograms per liter (µg/l). The detected compounds for each vadose zone well for both sampling events are given in Table 2-5.

Table 2-5: Soil Vapor Sample Analytical Summary of Detected Analytes

Well ID	Sampling Date	Detected Compounds
PZ1	4 November 1999	Dichlorodifluoromethane
	24 July 2000	Chloromethane, m/p-xylene, toluene
PZ2	4 November 1999	Acetone, dichlorodifluoromethane, tetrachloroethene
	24 July 2000	1,2,4-trimethylbenzene, acetone, carbon disulfide, chloromethane, m/p-xylene, toluene
PZ3	4 November 1999	All sample results were below the reporting limit
	24 July 2000	1,1-dichloroethane, 4-ethyltoluene, 1,2,4-trimethylbenzene, acetone, benzene, carbon disulfide, chloromethane, chloroethane, chloroform, dichlorodifluoromethane, ethylbenzene, m/p-xylene, o-xylene, toluene, vinyl chloride

3. DELINEATION OF WASTE PLACEMENT

The primary objective of trenching conducted by IT/OHM was to supplement the results of the geophysical survey and provide further information to assist with characterizing the type of waste and delineating waste placement.

3.1 EVALUATION OF TOPOGRAPHIC MAPS

The records search revealed the existence of pre-waste placement (circa 1972, with a 2-foot contour interval) (Figure 3-1) and post-waste placement (1990, with a 2-foot contour interval) (Figure 3-2) topography. The pre-waste placement bottom elevation is not precisely known. However, the 1972 topography predates the waste placement operations and was assumed to represent of the bottom of the waste. The 1990 topography was used to represent existing conditions. These topographic maps were used to estimate the lateral extent of the waste placement, the interface of the fill material with the native soil, the volume of the fill, and depth of water relative to the fill material.

The pre-waste placement topography was obtained from former MCAS El Toro archives as a 2-dimensional Microstation Computer-aided Design (CAD) drawing, and was then exported into a 3-dimensional Microstation CAD drawing. The post-waste placement topography was digitized into a 3-dimensional Microstation CAD drawing. The electronic files were then used to develop surfaces using InRoads engineering software. Cross sections were developed in InRoads at 100-foot intervals (see Figures 3-1 and 3-2) showing the estimated pre- and post-waste placement topographies. Once the cross sections were obtained, the water table elevations were transposed onto the cross sections. Ten cross sections were plotted in the northwest to southeast direction (i.e., lateral direction), and four cross sections were plotted in the northeast to southwest direction (i.e., longitudinal direction).

Subsequent to plotting the cross sections, the upper and lower extent, as well as the interface between the pre- and post-waste placement elevations, were reviewed to help develop the depth of waste and the tentative waste placement boundaries. The interface between the surfaces was estimated and subsequently plotted on the plan view at each corresponding cross section. Figures 3-3, 3-4, and 3-5 show the cross sections used to estimate the depth and the tentative waste placement boundary.

3.2 EVALUATION OF BORING AND TRENCH LOGS

The borehole logs of the vadose zone wells (PZ1, PZ2, and PZ3) and the monitoring wells (MW1, MW2, and MW4), and the trench logs were reviewed to assist in the delineation. The boring logs of the wells did not reveal any evidence of waste. Trench logs for trenches H4, H5, H6, H7, H8, 7E, and 8E (which extended across the perimeter of Anomaly Area 3) defined the limits of waste placement. In addition to the results of review of the topographic maps, the details from these logs were used to estimate the boundary of waste placement.

3.3 ESTIMATE OF EXTENTS

Using the evaluation described above, the depth and the tentative horizontal extent of the waste were estimated. The maximum depth of waste is approximately 25–30 feet. Figure 3-6 shows the lateral extent of waste.

The cross sections, together with the results of the report documenting the geophysical investigation conducted by IT/OHM, borehole logs, and trench logs provide a general estimate of the depth, extent, and content of waste at Anomaly Area 3. These cross sections and the tentative waste placement boundary will assist in the decision-making process during further investigations at the site.

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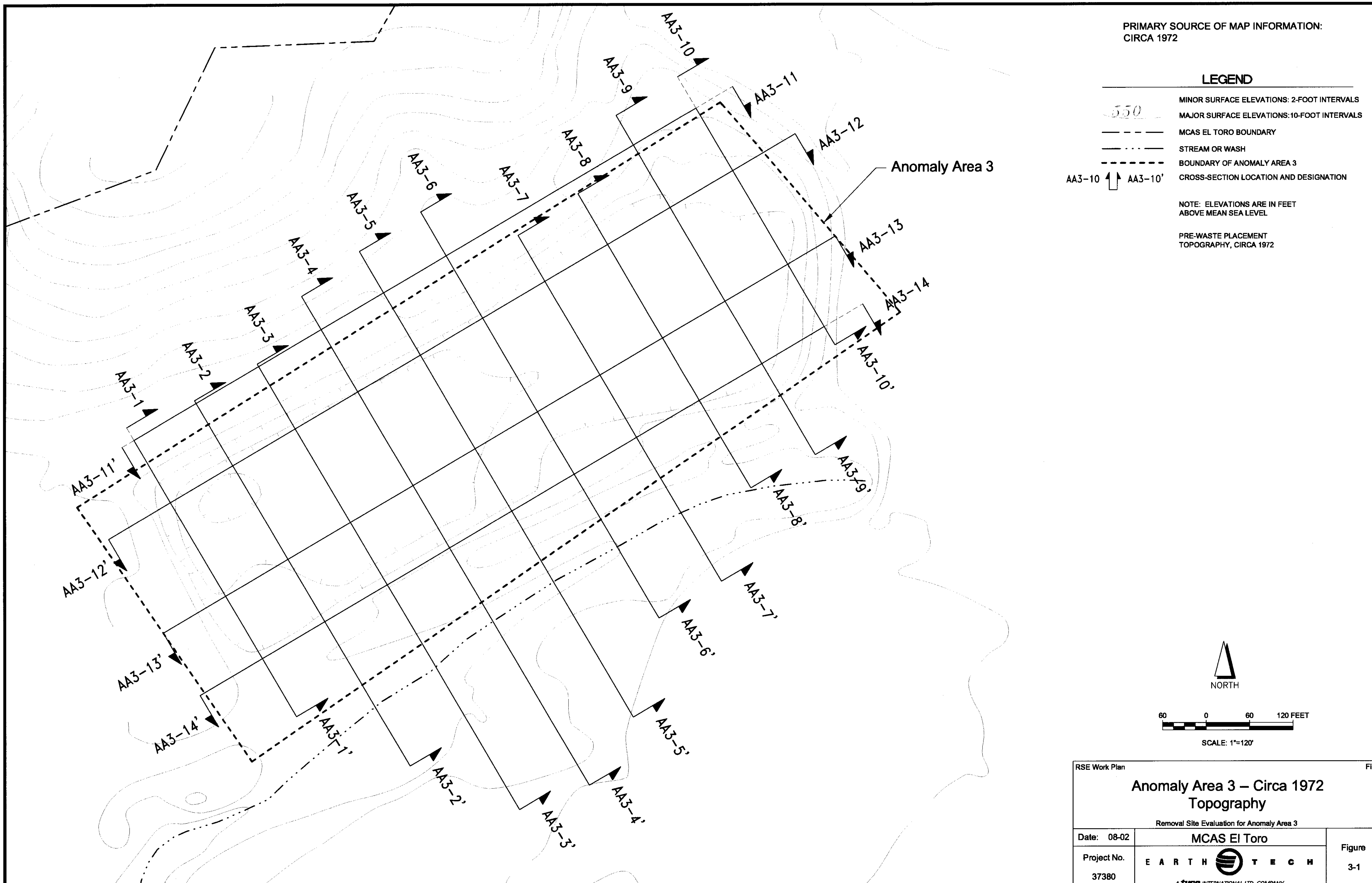

RSE Work Plan

Final

Anomaly Area 3 – Circa 1972 Topography

Removal Site Evaluation for Anomaly Area 3

Date: 08-02	MCAS El Toro	Figure
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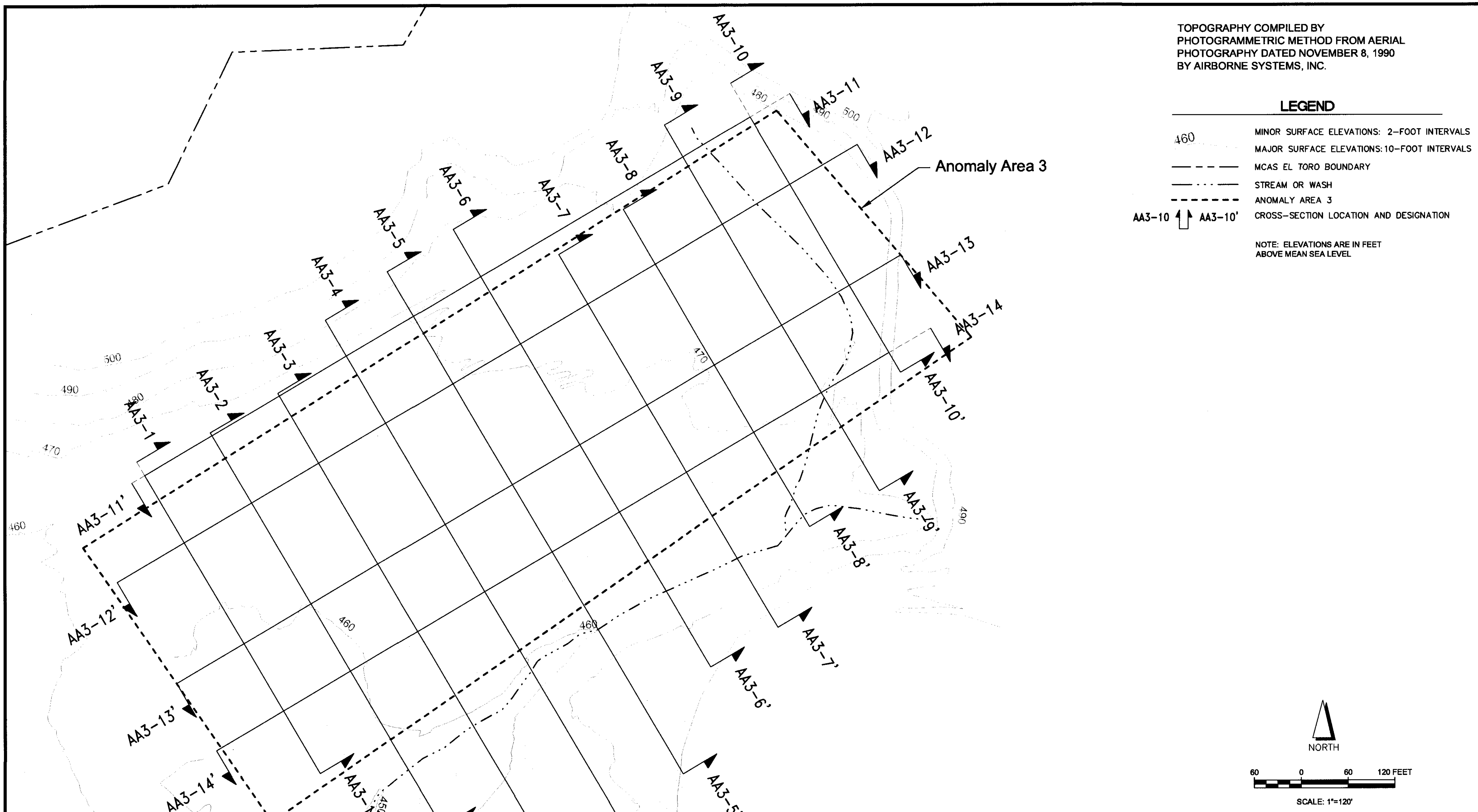

RSE Work Plan | Final

Anomaly Area 3 – 1990 Topography

Removal Site Evaluation for Anomaly Area 3

Date: 08-02 | MCAS El Toro | Figure 3-2

Project No. 37380

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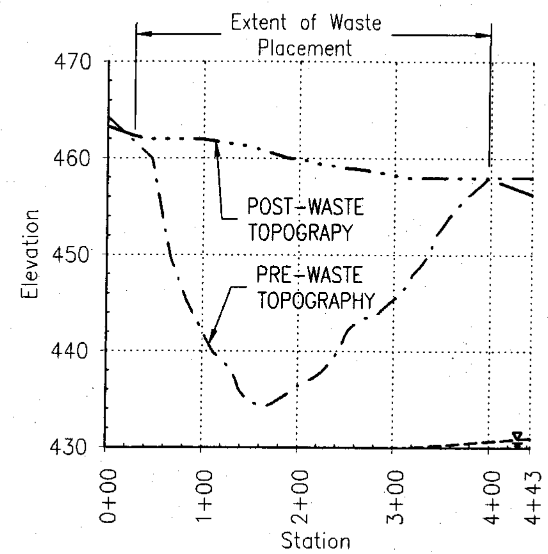

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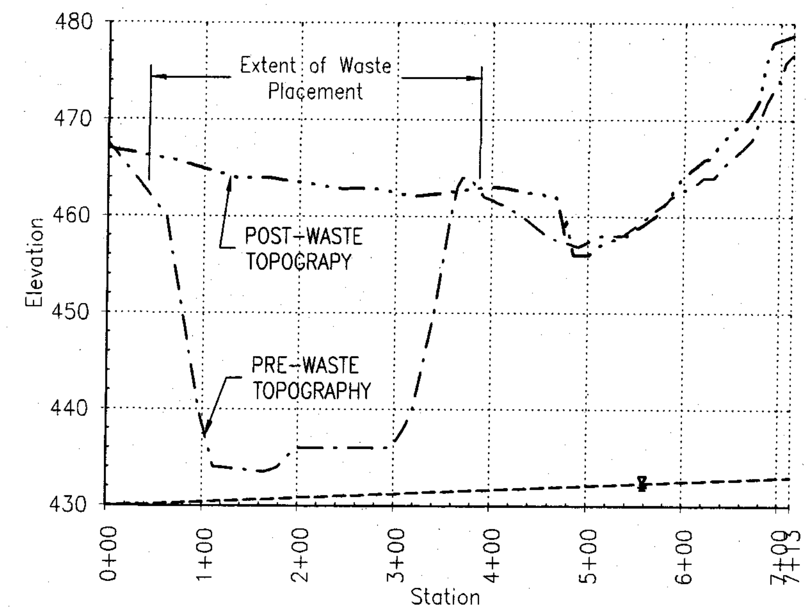

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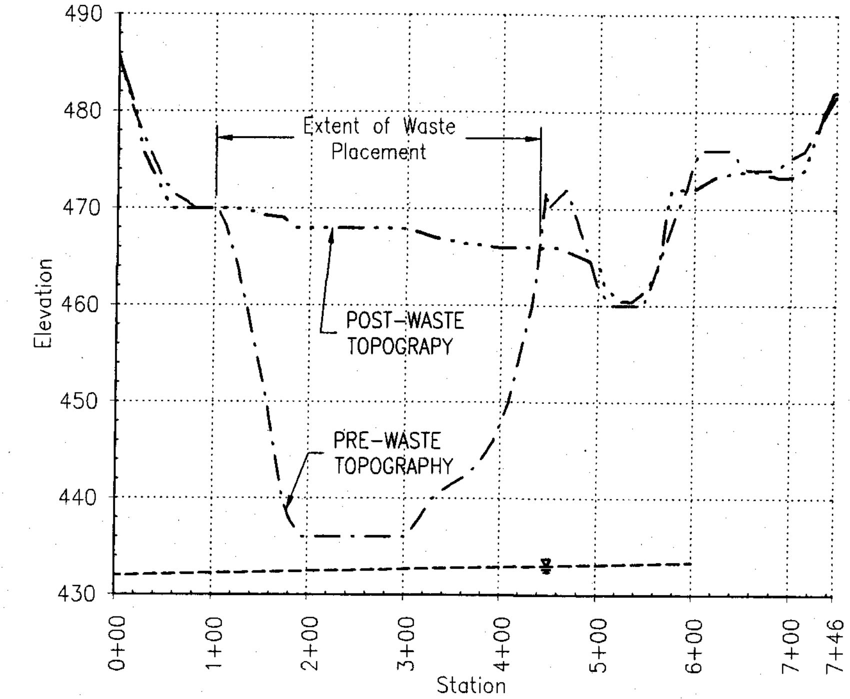

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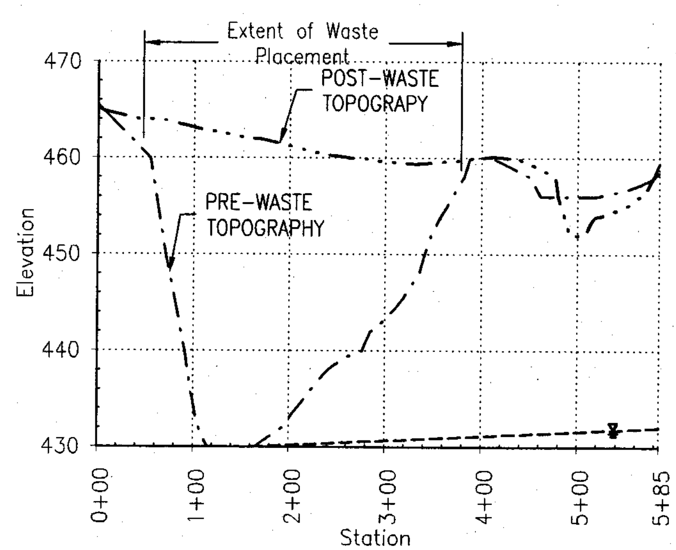

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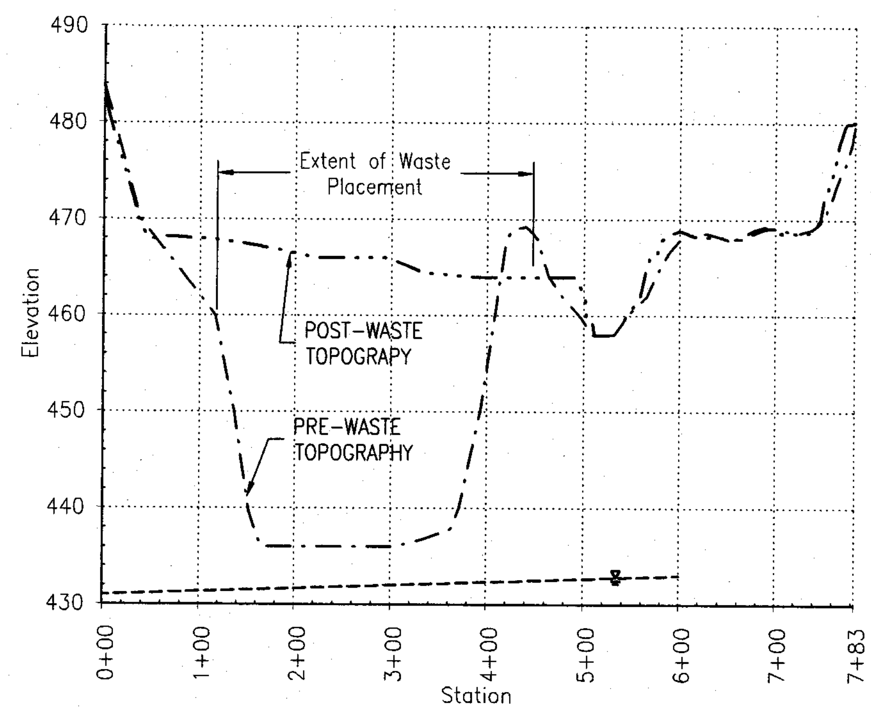

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LEGEND

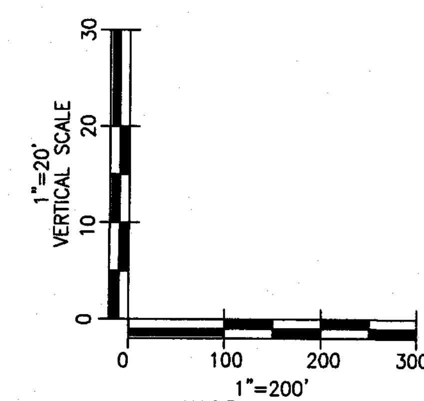
PRE-WASTE PLACEMENT TOPOGRAPHY

POST-WASTE PLACEMENT TOPOGRAPHY

APPROXIMATE GROUNDWATER ELEVATION

POST–WASTE PLACEMENT TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHOD FROM AERIAL PHOTOGRAPHY DATED NOVEMBER 8, 1990 BY AIRBORNE SYSTEMS, INC.

PRE–WASTE PLACEMENT TOPOGRAPHY CIRCA 1972



RSE Work Plan — Final

Cross Sections -- I

Removal Site Evaluation for Anomaly Area 3

Date: 08-02 | MCAS El Toro | Figure 3-3

Project No. 37380

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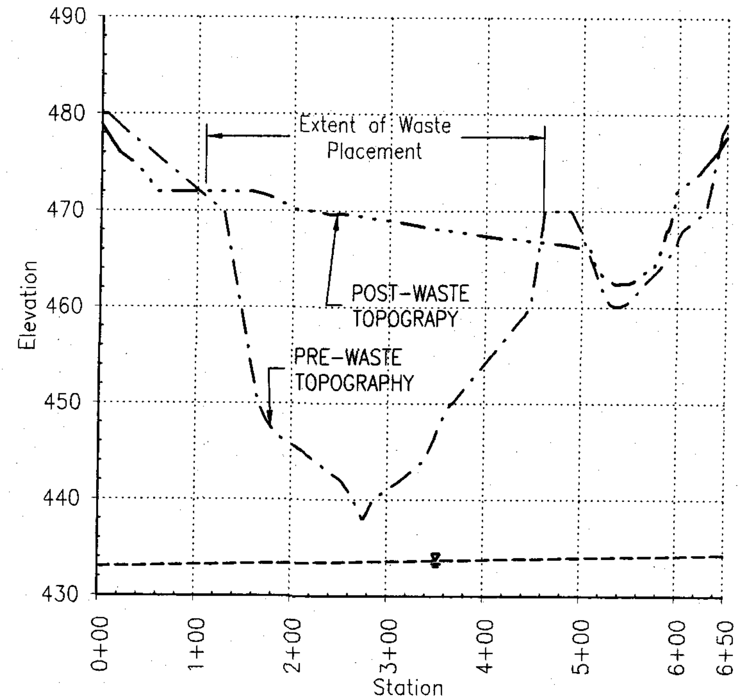
POST–WASTE PLACEMENT TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHOD FROM AERIAL PHOTOGRAPHY DATED NOVEMBER 8, 1990 BY AIRBORNE SYSTEMS, INC.

PRE–WASTE PLACEMENT TOPOGRAPHY CIRCA 1972



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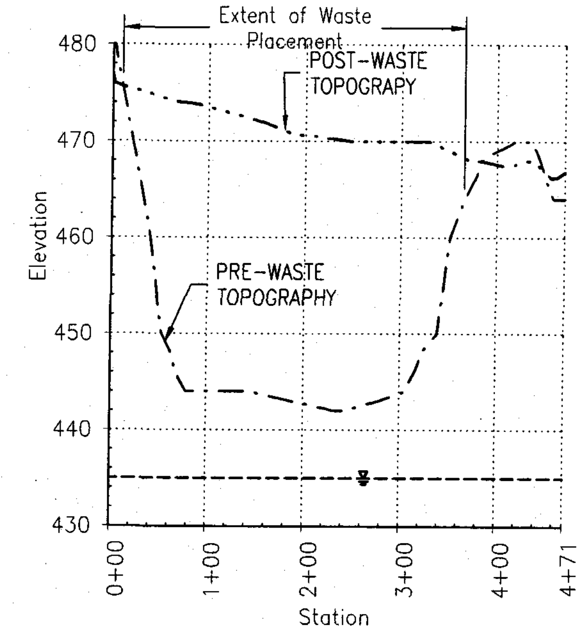

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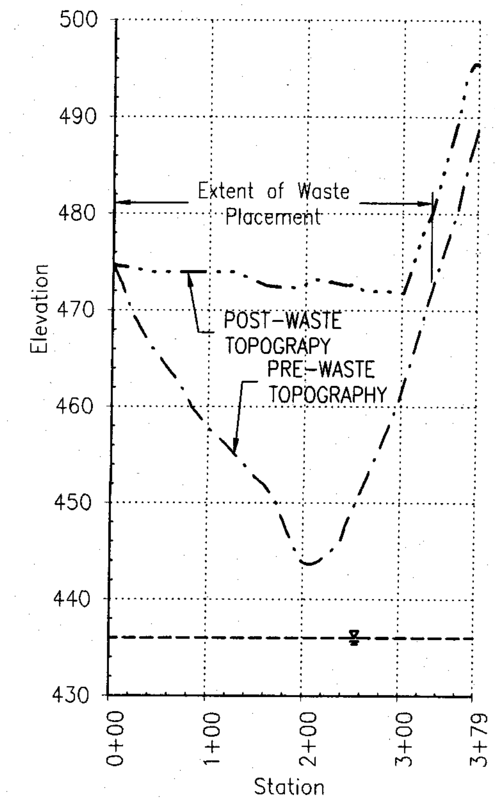

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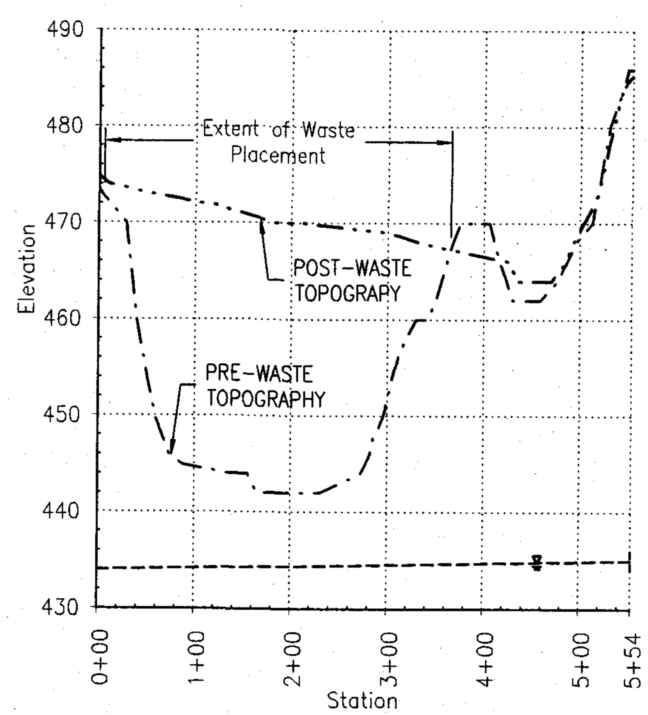

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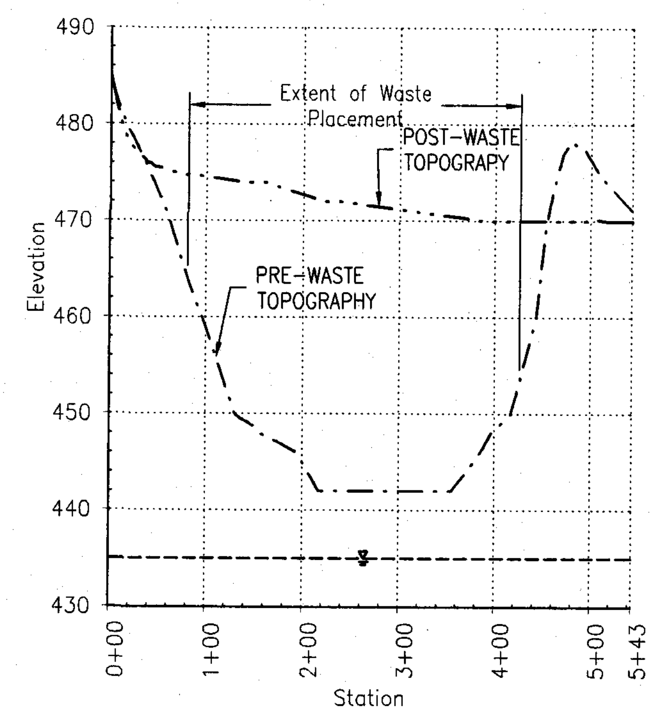

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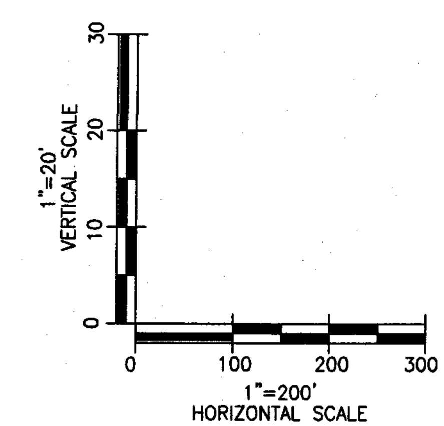

RSE Work Plan | Final

Cross Sections -- II

Removal Site Evaluation for Anomaly Area 3

MCAS El Toro

Date: 08-02
Project No. 37380

EARTH TECH
A tyco INTERNATIONAL LTD. COMPANY

Figure 3-4

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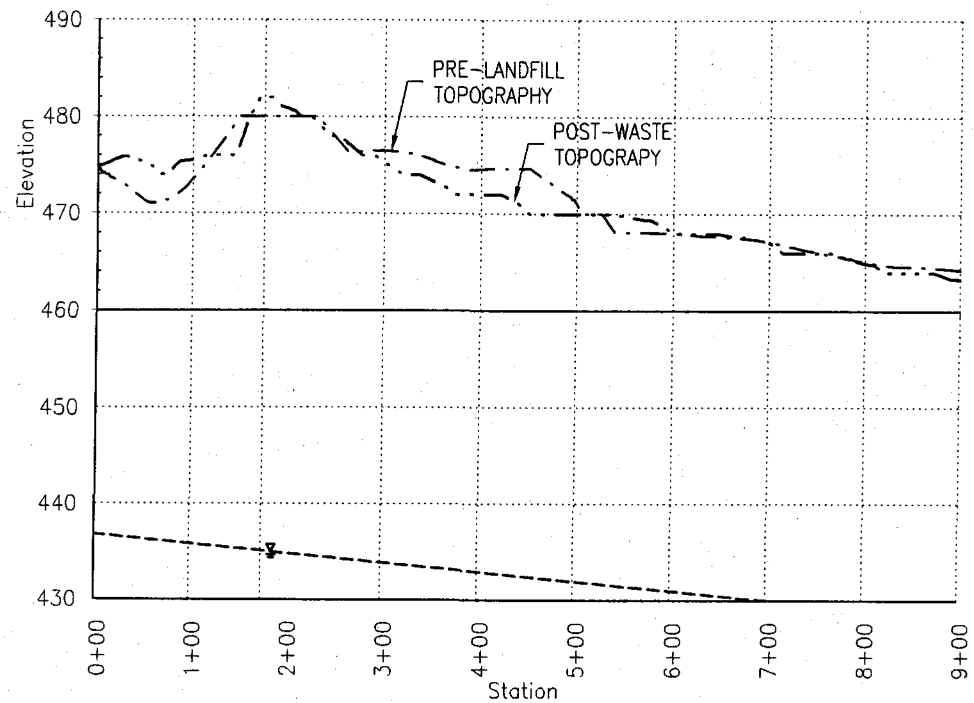

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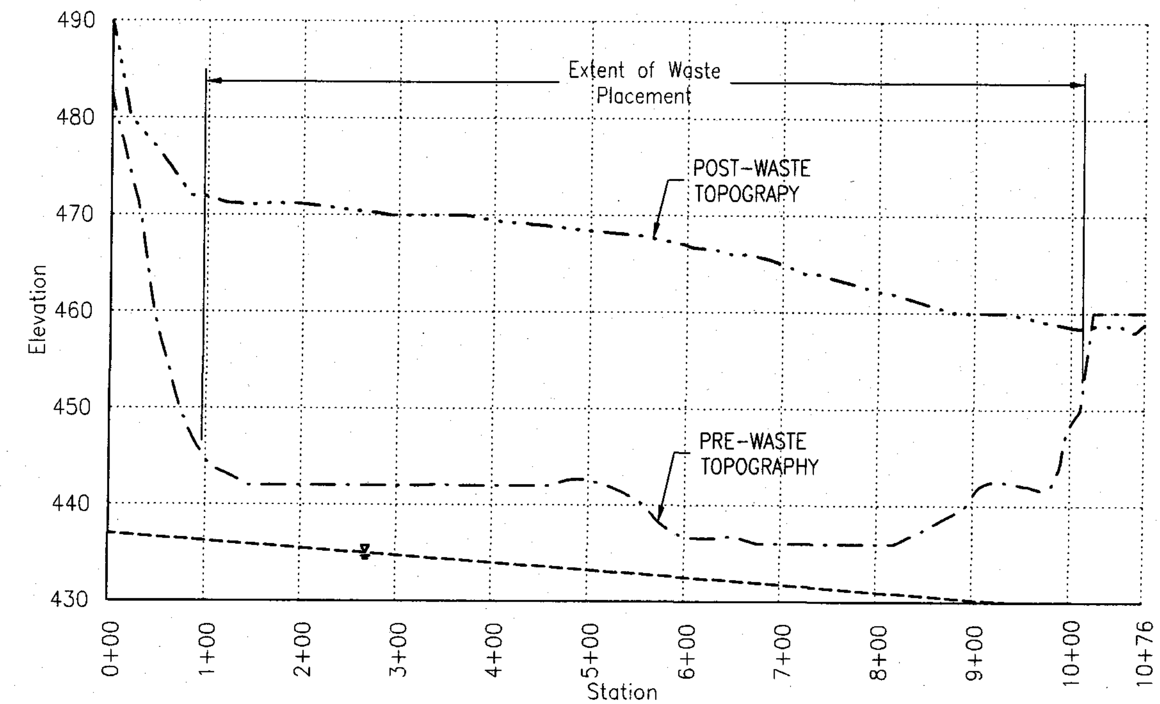


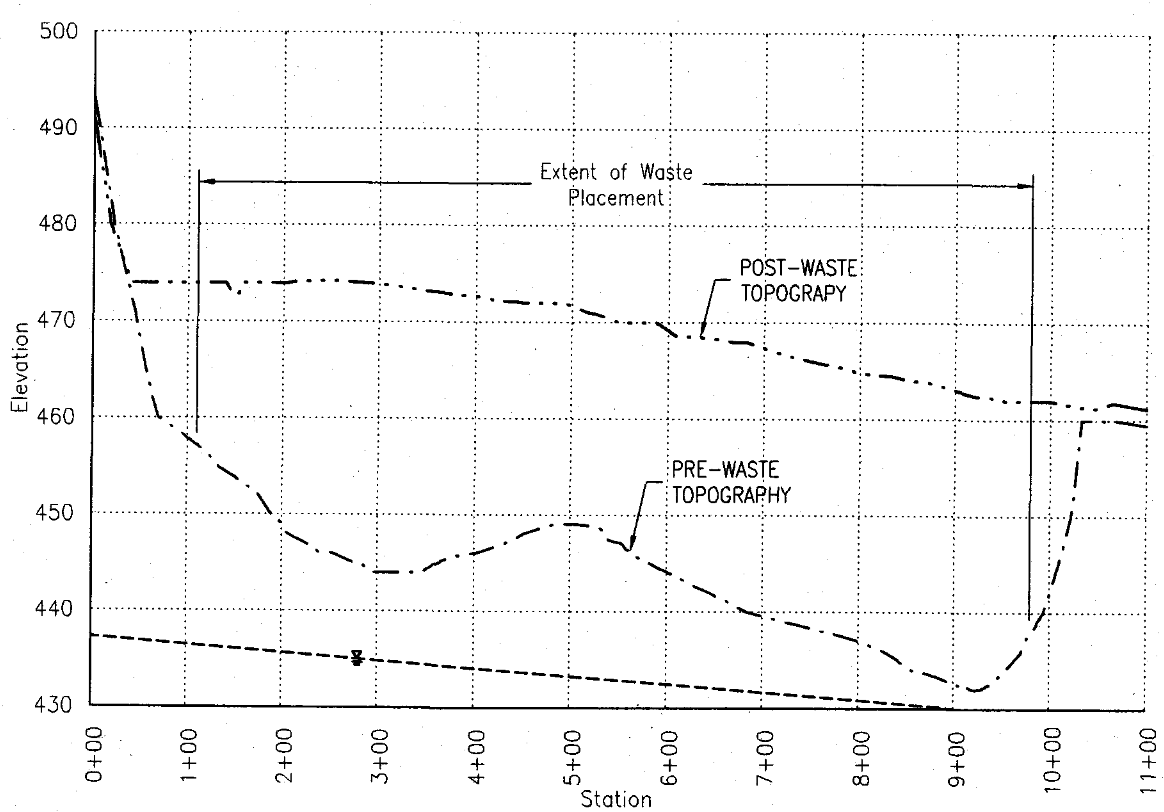
SECTION AA3--13-13'
SCALE: 1"=200' Horizontal
1"=20' Vertical

LEGEND

PRE-WASTE PLACEMENT TOPOGRAPHY
POST-WASTE PLACEMENT TOPOGRAPHY
APPROXIMATE GROUNDWATER ELEVATION

POST-WASTE PLACEMENT TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHOD FROM AERIAL PHOTOGRAPHY DATED NOVEMBER 8, 1990 BY AIRBORNE SYSTEMS, INC.

PRE-WASTE PLACEMENT TOPOGRAPHY CIRCA 1972



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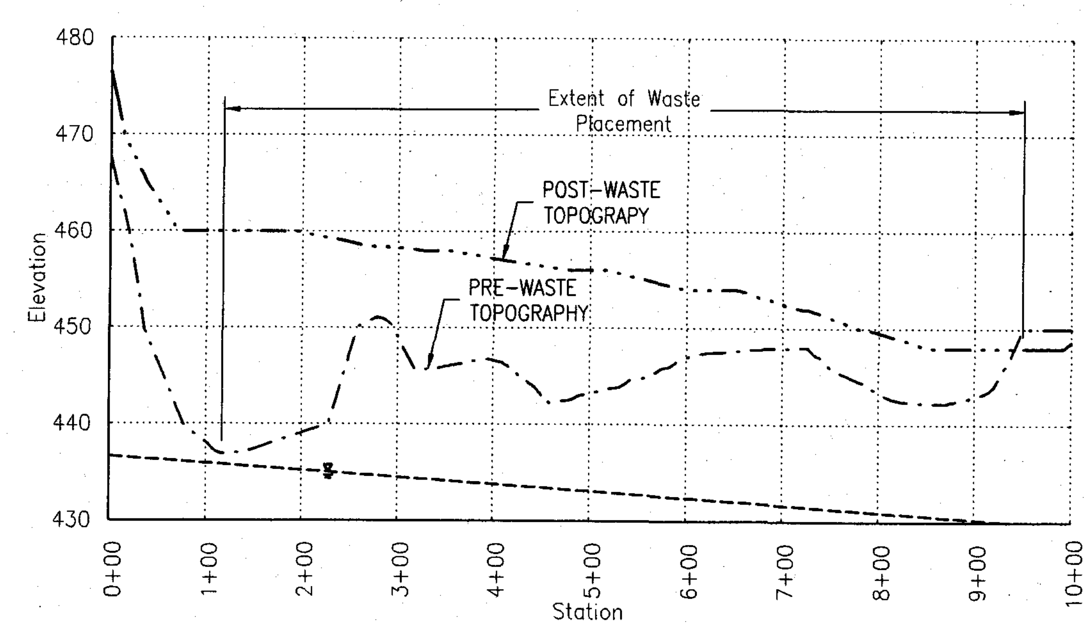

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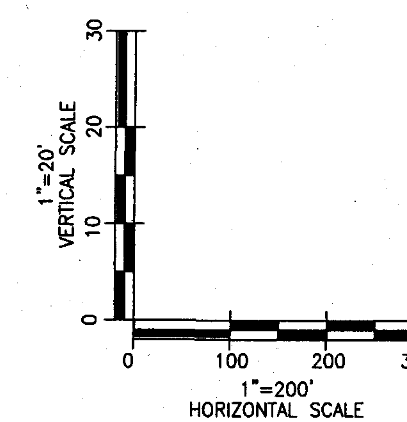

RSE Work Plan		Final
Cross Sections -- III		
Removal Site Evaluation for Anomaly Area 3		
Date: 08-02	MCAS El Toro	Figure
Project No. 37380	EARTH TECH A tyco INTERNATIONAL LTD. COMPANY	3-5

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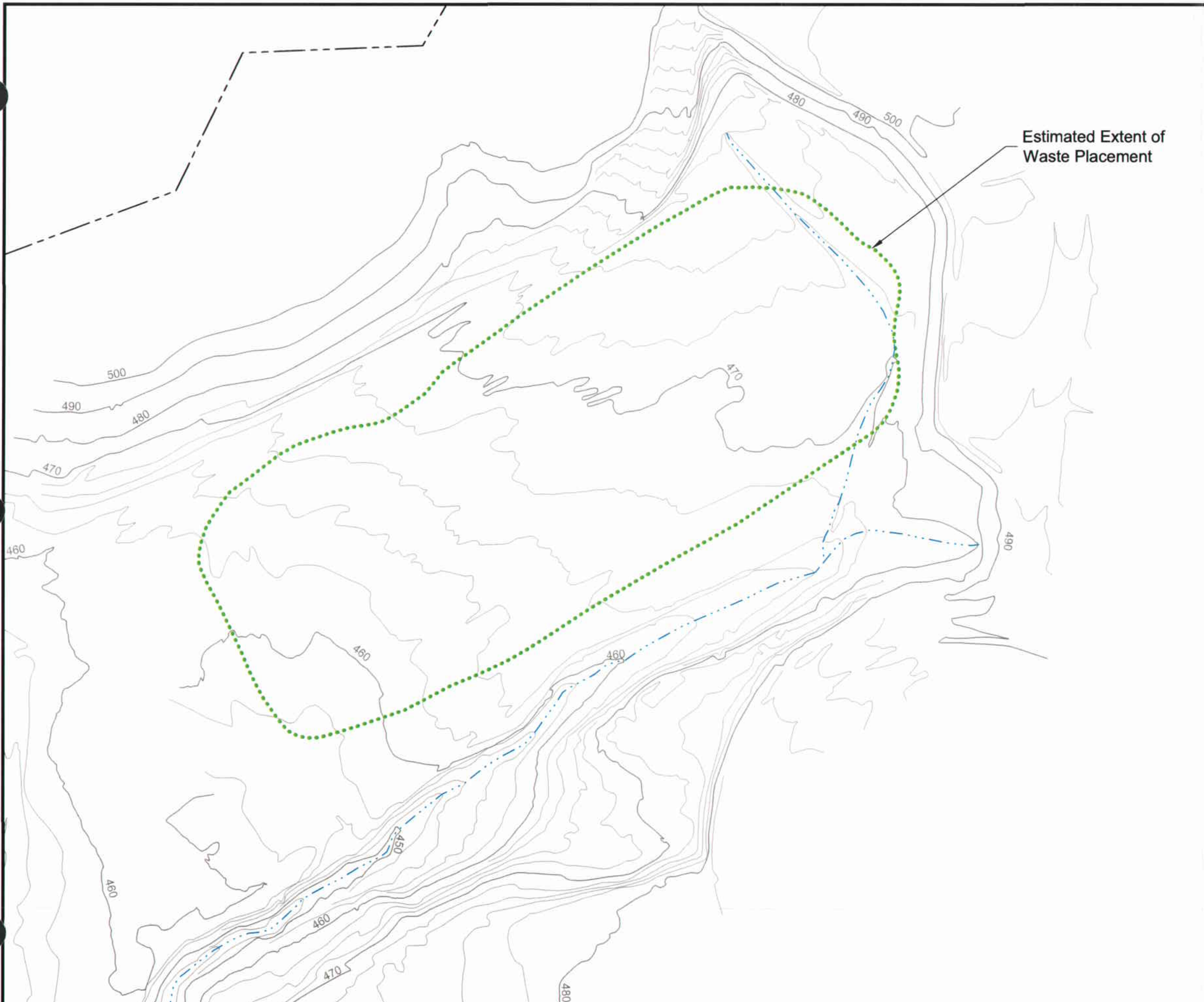

TOPOGRAPHY COMPILED BY
PHOTOGRAMMETRIC METHOD FROM AERIAL
PHOTOGRAPHY DATED NOVEMBER 8, 1990
BY AIRBORNE SYSTEMS, INC.

LEGEND

460 MINOR SURFACE ELEVATION: 2-FOOT INTERVALS
MAJOR SURFACE ELEVATION:10-FOOT INTERVALS
MCAS EL TORO BOUNDARY
STREAM OR WASH
ESTIMATED EXTENT OF WASTE PLACEMENT

NOTE: ELEVATIONS ARE IN FEET
ABOVE MEAN SEA LEVEL

RSE Work Plan Final

Estimated Extent of Waste Placement

Removal Site Evaluation for Anomaly Area 3

Date: 08-02	MCAS El Toro	Figure
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4. WORK PLAN APPROACH

4.1 INITIAL EVALUATION

A conceptual site model for Anomaly Area 3 was developed based on the review of existing site information presented in the *Anomaly Area 3 Technical Information Package* (IT/OHM 2000). Updated information on waste sources, pathways, and receptors at the site were used to develop a conceptual understanding of the site to evaluate potential risks to human health and the environment.

Figure 4-1 illustrates the conceptual site model (CSM), and Figure 4-2 identifies the potential exposure routes and pathways for human and ecological receptors.

4.1.1 Sources and Release Mechanisms

Potential contaminants have been released in the shallow soil (up to a depth of 25–30 feet bgs) as a result of waste placement. Groundwater is present at depths of 22 feet to 63 feet bgs. The primary source of potential contamination is construction debris including corrugated steel, asphalt, and reinforced concrete debris.

4.1.2 Exposure Pathways

The potential pathways for human and ecological receptors are direct contact with surface and subsurface soils, air, groundwater, and surface water and sediment runoff. Although runoff is normally limited to that within the site, the location of Agua Chinon Wash immediately adjacent to the southeast boundary causes the possibility of mixing of site runoff with runoff in Agua Chinon Wash. Thus, the surface-water pathway is considered potentially complete for human and ecological receptors.

Airborne contaminants are primarily transported through volatilization and fugitive dust emissions from site surfaces. Both volatilization and fugitive dust releases are considered insignificant human and ecological exposure pathways because VOCs and other analytes evaluated from shallow soil sampled at depths less than 5 feet bgs were reported at either non-detectable levels or levels less than EPA Region 9 PRGs. Consequently, exposure via the inhalation route is insignificant, and the air pathway is incomplete. Analytical results from this investigation will be used to confirm this inference.

In summary, pathways warranting further consideration are the following:

- Surface and subsurface soil pathways for both human and ecological receptors
- Surface water pathway for both human and ecological receptors
- Groundwater pathway for both human and ecological receptors

4.1.3 Land Use and Receptors

Previous land use at the site was industrial. The Wherry Housing Area is located to the northeast and to the south of Anomaly Area 3 and consists of single-family residences. However, since the operational closing of MCAS El Toro, the Wherry Housing Area is no longer used. The site is currently fenced along the northwest and southwest sides, with vegetation surrounding the remainder of the site. Authorized visitors and escorts are the only current human receptors on the site. The preliminary reuse scenario proposed for Anomaly Area 3 and surrounding areas is parklands. Therefore, potential future human receptors at Anomaly Area 3 include industrial workers, construction workers, agricultural workers, and recreational users. In summary, human receptors for consideration are as follows:

- Current workers and authorized visitors
- Future industrial, construction, agricultural workers, and recreational users

4.2 DATA QUALITY OBJECTIVES

This work plan has been developed using the data quality objective (DQO) process (EPA 2000a). Relevant elements of the DQOs that were formulated and presented in the earlier work plan for the stationwide phase II remedial investigation (BNI 1995) have been incorporated into this plan.

4.2.1 Problem Statements

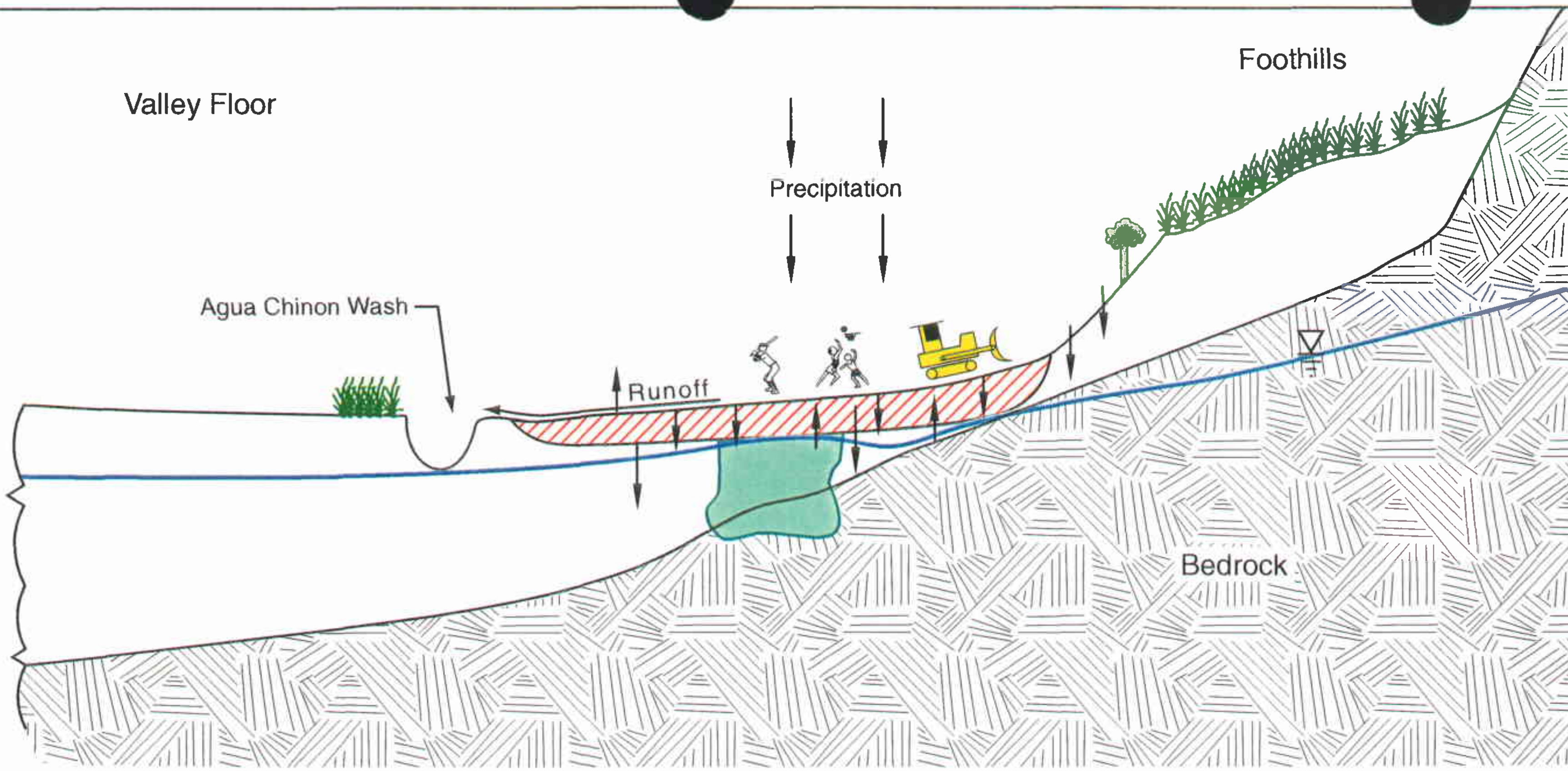
1. Anomaly Area 3 was initially used as a borrow source. Subsequently, it was apparently used for the disposal of construction debris. The impact to the subsurface soils and groundwater has not been adequately evaluated.
2. Geophysical surveys conducted at the site (IT/OHM 2000) identified several anomalies that require further investigation.
3. Subsurface trenching performed subsequent to the geophysical surveys did not adequately characterize the area and total depth of waste buried at Anomaly Area 3.
4. Current soil data may not be adequate to comprehensively identify the presence of chemicals of potential concern (COPCs) or evaluate human health and ecological risk posed by the site.
5. Complete delineation of waste placement boundaries and characterization of waste properties at Anomaly Area 3 is necessary to protect human health and the environment and implement a removal action, if required.

4.2.2 Project Decision Questions

Study Question. Are adequate data available to complete an RSE, including the design of a cover system? What is the risk posed by the site to human health and/or the environment?

Project Decisions. To resolve the principal study questions, the following decision questions will be considered:

1. Have the waste boundaries been adequately delineated, or is further evaluation required?
2. Has the existing soil cover been adequately characterized (thickness and soil properties), or is further evaluation required?
3. Are adequate data available to characterize if the existing soil cover is sufficient to either protect human health and environment, or if not, to serve as a foundation layer for a soil cover system?
4. Has the impact to groundwater, surface water, and sediments been adequately characterized, or are additional data required?



Explanation

Receptors

- Workers
- Recreation Users
- Habitats
- Tree

Pathways

- Infiltration
- Groundwater
- Wastes
- Leaching
- Dissolved-Phase Contaminants
- Vapor Emissions

RSE Work Plan		Final
Conceptual Site Model Removal Site Evaluation for Anomaly Area 3		
Date 08-02	MCAS El Toro	Figure 4-1
Project No. 37380	EARTH TECH	

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Contaminant Source	Transport Mechanism	Exposure Route	Potential Receptors[1]: Current/Future Onsite Industrial Workers	Current/Future Onsite Construction Workers	Current/Future Offsite Agricultural Workers	Future Onsite Recreational Users	Current/Future Onsite Ecological Receptors	Rationale/Data Needs
Surface Soil	Direct Contact	Dermal Absorption	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Potentially Complete	Direct contact with surface soil is potentially complete for future industrial workers, construction workers, and ecological receptors (current and future).
		Incidental Ingestion	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Potentially Complete	
	Air Transport	Inhalation of VOCs	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Potentially Complete	Inhalation of contaminated dust is potentially complete for all onsite receptors, but not for offsite receptors.
		Inhalation of Particulates	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Potentially Complete	
	Surface Water Runoff	Dermal Absorption	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Surface water runoff and transport of dissolved contaminants is likely because of mixing with surface water from Agua Chinon Wash.
		Incidental Ingestion	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	
		Inhalation of VOCs	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	
		Bio-accumulation/ Consumption of Food	Incomplete	Incomplete	Incomplete	Incomplete	Potentially Complete	

Figure 4-2
Conceptual Site Model - Potential Exposure Scenarios
Draft Work Plan-Removal Site Evaluation
Anomaly Area 3, MCAS El Toro

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Contaminant Source	Transport Mechanism	Exposure Route	Potential Receptors[1]: Current/Future Onsite Industrial Workers	Current/Future Onsite Construction Workers	Current/Future Offsite Agricultural Workers	Future Onsite Recreational Users	Current/Future Onsite Ecological Receptors	Rationale/Data Needs
Subsurface Soil	Unsaturated/ Saturated Zone Transport to Leachate to Groundwater	Dermal Absorption	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Exposure to groundwater is potentially complete if groundwater is pumped for agricultural use or becomes a future source of drinking water.
		Incidental Ingestion	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	
		Inhalation of VOCs	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	
		Bio-accumulation/ Consumption of Food	Incomplete	Incomplete	Incomplete	Incomplete	Potentially Complete	
	Direct Contact	Dermal Absorption	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Insignificant	Direct contact with subsurface soil is potentially complete for construction workers, recreational users, and industrial workers if future construction work brings subsurface soil to the surface. Exposure of ecological receptors is assumed to be insignificant in areas of industrial development due to disruption of habitat.
		Incidental Ingestion	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Insignificant	

Note: [1] Ecological receptors and offsite agricultural well users are present for current and potential future use conditions; all other receptors are for potential future use conditions.

Figure 4-2 (continued)
Conceptual Site Model - Potential Exposure Scenarios
Draft Work Plan-Removal Site Evaluation
Anomaly Area 3, MCAS El Toro

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5. Is soil vapor being produced within the waste, and if yes, does it exceed threshold levels listed as decision inputs and require a waste placement gas collection system?
6. Does soil vapor migrate from the site to impact adjacent property?
7. Has the nature of the waste present been adequately characterized using soil vapor, soil, groundwater, surface water, and sediments data, or is further evaluation required to characterize risk and evaluate response actions?
8. Have potential human and ecological receptors been identified, and are they likely to be at risk for adverse health effects at this site?

4.2.3 Decision Inputs

Prior work at this site, as discussed in Section 3, was used to develop the scope of this investigation. Sampling performed at Anomaly Area 3 in the course of this investigation will be used to resolve the decision project questions. Data that will serve as input to the decisions are listed below.

1. Analytes expected to be characteristic of releases during waste placement will be used to identify COPCs. The chemical groups include metals, VOCs, SVOCs, polychlorinated biphenyls (PCBs), dioxins/furans, and petroleum hydrocarbons. Target analytes within chemical groups are listed in the QAPP of this work plan.
2. Soil vapor samples from within and at the perimeter of the waste placement will be analyzed for VOCs and fixed gases to assess the presence of a release.
3. Groundwater samples from wells in and around the waste will be used to assess groundwater characteristics as well as evaluate the presence of COPCs.
4. Previous soil, groundwater, and soil vapor sample analytical data have been incorporated into the sampling and analysis program.
5. Results of the geophysical survey and trenching that were previously conducted will be incorporated into the sampling and analysis program.
6. EPA Region 9 PRGs (EPA 2000b) (residential and industrial) will be used as screening criteria for human health risk.
7. Results from the ongoing radiological survey (Weston 2000) will be used to assess if additional radiological sampling is required.

The following threshold levels will be used as screening criteria for further assessment of detected analytes:

1. MCAS El Toro area background metals and selected organic compound concentrations in soil. The background thresholds for metals were developed and presented in the *Final Technical Memorandum, Background and Reference Levels, Remedial Investigations* (BNI 1996). Concentrations of analytes that exceed the background threshold (95th quantile) will be compared to the residential and industrial soil PRGs.
2. EPA Region 9 (California [Cal]-EPA modified) PRGs and soil screening levels (SSLs) for industrial and residential use scenarios for soil for analytes other than metals.
3. For groundwater and surface water, federal and California MCLs or drinking water advisory thresholds for drinking water, where available. In the absence of MCLs, EPA Region 9 PRGs for tap water will be used.
4. Target compounds for dioxin and dioxin-like compounds will be the analytes in the WHO list of compounds. Table 2-3 shows toxicity equivalency factors. The product of the analyte

concentration and its associated TEF will be compared with the residential and industrial soil PRG for the dioxin 2,3,7,8-TCDD, as well as current EPA Office of Solid Waste and Emergency Response (OSWER) guidance for the evaluation of dioxin contamination in residential and industrial settings.

5. California DHS action levels for perchlorate (4 μg/L) in groundwater and surface water.
6. California Air Resources Board (CARB) study median concentrations that were proposed for the integrated and ambient air samples in the *Phase II RI Work Plan* (BNI 1995).
7. Title 27 of the California Code of Regulations (CCR) stipulated the lower explosive limit (LEL) for methane (5 percent by volume or 50,000 parts per million by volume [ppmv]) for soil vapor.
8. Soil vapor hot spot threshold for total VOC concentration (300 μg/L) as established in the *Phase II RI Work Plan* (BNI 1995) for typical landfill sites.
9. The proposed future use of Anomaly Area 3 (parklands) in accordance with the *MCAS El Toro Community Reuse Plan* (DoN 2000) and associated exposure scenarios will be incorporated into the risk evaluation.

4.2.4 Study Boundaries

Anomaly Area 3 encompasses approximately 9 acres. It is bordered to the northeast by Pusan Way and to the southeast by Agua Chinon Wash (see Figure 2-1). The former Wherry Housing Area is further to the southeast and northeast. Groundwater at the site is found at approximately 22 feet to 63 feet bgs. Waste placement extends from near the surface to approximately 25–30 feet bgs. This study considers Anomaly Area 3 as one site, and the vertical depth of the investigation will progress to approximately the first encountered groundwater.

Figure A-3-2 in Appendix A presents the timeline for the Anomaly Area 3 investigation.

4.2.5 Decision Rules

1. ***If*** the waste placement has not been adequately delineated, ***then*** additional trenching and/or soil sampling will be performed to define the waste placement boundaries (project decision question 1).
2. ***If*** the existing soil cover has not been characterized adequately, ***then*** additional sampling will be conducted to determine the thickness and engineering properties of the cover (project decision question 2).
3. ***If*** the existing cover has been adequately characterized, ***then*** the data will be used to assess whether the existing cover is adequate to protect human health and the environment (project decision question 3).
4. ***If*** groundwater has not been adequately characterized, ***then*** additional data will be collected. Additional data sources include existing groundwater monitoring wells or installation of additional wells (project decision question 4).
5. ***If*** impact to surface water and sediments has not been adequately characterized, ***then*** two additional attempts to collect surface water and sediment samples will be made; if additional attempts are also unsuccessful in obtaining samples, then this exposure pathway will be considered to be incomplete based on the conclusion that site conditions do not produce surface water andsediment samples (indicating that these media are not potentially present) (project decision question 4).

6. ***If*** the results of shallow soil vapor sampling indicate that soil vapor is present within the waste, ***then*** additional soil vapor sampling will be conducted to delineate "hot spots" within the waste (project decision question 5).

   - Since contaminated soil vapor is indicative of possible soil contamination, additional subsurface soil samples will be collected from any locations deemed "hot spots".

7. ***If*** results of perimeter soil vapor sampling indicate that soil vapor is migrating, ***then*** the need for a soil vapor collection system will be evaluated (project decision question 6).
8. ***If*** soil vapor, soil, groundwater, surface water, and sediment analytical data are not adequate to characterize the risk and evaluate response actions, ***then*** additional sampling will be conducted (project decision question 7).
9. ***If*** the screening/site-specific preliminary risk evaluation (PRE) indicates risk which is

   a) Less than 10^{-6}, ***then*** no further remedial action will be recommended based on risk mitigation. The BCT will evaluate response action options (project decision question 8);

   b) Between 10^{-6} and 10^{-4}, ***then*** the BCT will evaluate risk management decisions and response action options will be evaluated (project decision question 8);

   c) Greater than 10^{-4}, ***then*** response actions will be evaluated (project decision question 8).

4.2.6 Decision Error Limits

Limits on the probability of decision error are established in the sampling design and represent balancing the cost of the project design with the likelihood of an incorrect decision.

Decision errors may lead to the conclusion that contamination is present where none exists or concluded that contamination is absent when it is actually present. The estimate of the potential for decision error of a judgmental sampling design is qualitative. The design proposed for this investigation is judgmental. Although a grid sampling approach has been selected to locate the samples, no data are available from which an estimate of the size of a "hot spot" may be derived. However, the discussion of the potential for error in the design is presented, and the strategies to control that error (and the resultant decision error) are incorporated into the design.

Locations of the sampling points will be selected based on the topographic maps, facility plans, and drawings. Sample points will be located along alignments of a 100-foot by 100-foot grid system (Figure 4-3). Error in the sampling design will be minimized by field verification of drawings and accurate mapping of sampling locations and target areas.

The analytical methods selected will be documented and will include appropriate verification and validation, as reflected in the QAPP in Appendix A. Field and fixed laboratory data packages will be independently reviewed for compliance with the methods and specifications of the sampling design. Sampling methods will include field duplicates to assess repeatability and representativeness of the sampling procedures. Sampling methods will follow established operating procedures and be independently documented by field supervisors.

The following potential qualitative decision errors are identified and are presented as Table 4-1.

Table 4-1: Qualitative Analysis of Decision Errors and Tolerances

Rule	Possible Errors	Associated Consequences	Gray Areas	Methods to Control Error
1	Concluding that one or more COPCs are present when there is none. Concluding that no COPCs are present when they are.	Unnecessary corrective action Failure to take appropriate corrective action	Uncertainty associated with sample locations and the measurement of analyte concentrations	Sampling design, standardized analytical processes, and a quality management system
2	Concluding that the analyte is background (natural or anthropogenic) when it is a contaminant Concluding that the analyte is a contaminant when it is background	Failure to take appropriate corrective action Unnecessary corrective action	Uncertainty associated with determination of background thresholds Sampling within the representative populations	Use of established methods for characterization of background
3	Concluding the analyte is a hot spot when it is areawide contamination Characterizing the contaminant as areawide when it is a hot spot	Recommendations, which don't address true conditions	Uncertainty associated with definition of a hot spot Samples which adequately characterize the population	Sufficient assessment of identified potential contamination
4	Concluding that removal is not required when it is. Concluding that removal is required when it is not	Failure to take appropriate corrective action. Unnecessary corrective action	Uncertainty associated with definition of a hot spot (the area requiring a corrective action)	Sufficient assessment of identified potential contamination
5	Concluding that the site is sufficiently assessed when it has not been. Concluding the site is not sufficiently assessed when it has been	Failure to collect sufficient samples to adequately characterize the site Unnecessary sampling and analysis	Uncertainty associated with assumptions used to establish the sampling design	Validation of design assumption with the results

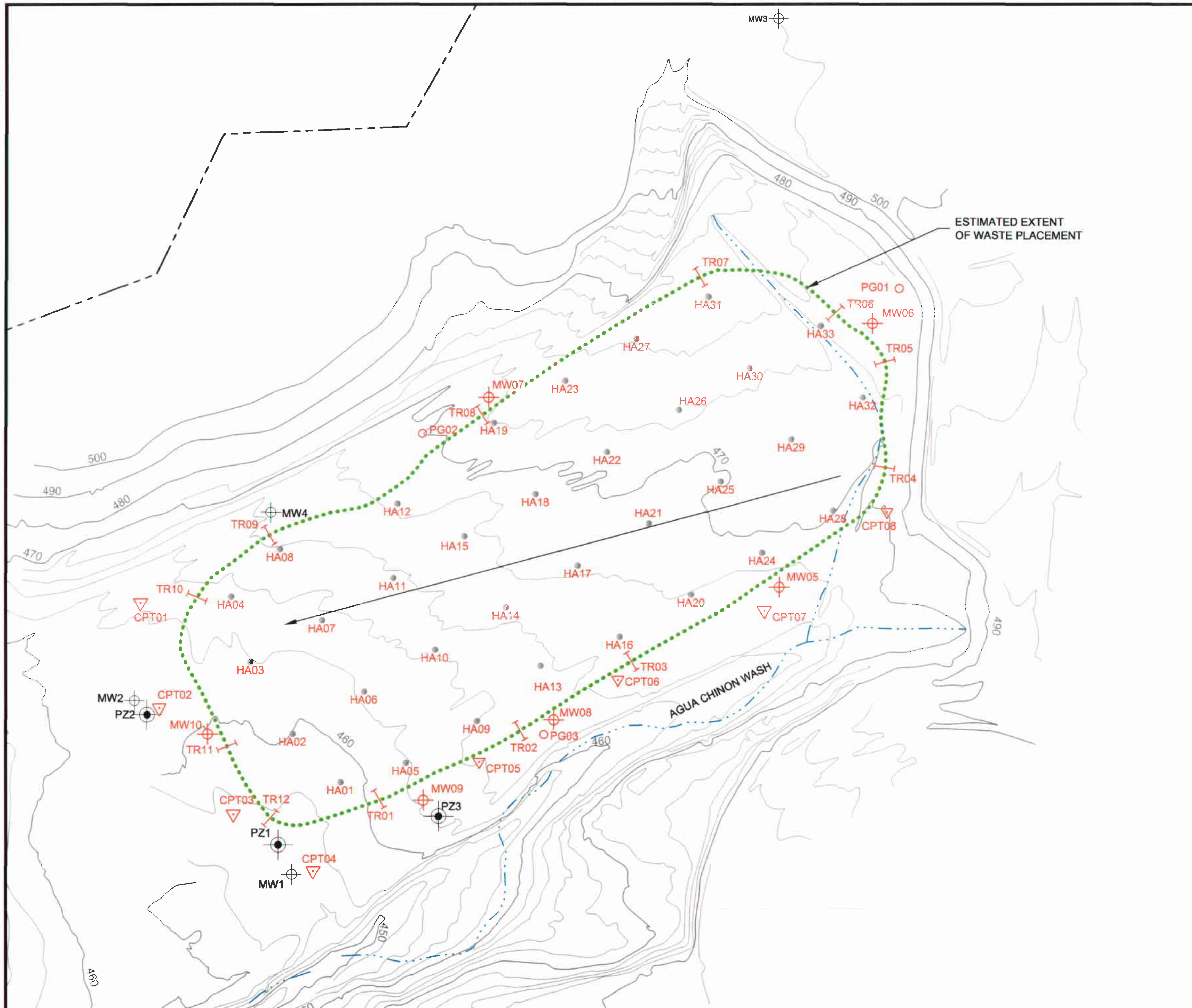
4.2.7 Sampling Design

The RSE sampling design that has been developed is based on a grid sampling approach using a centrally aligned grid to allow uniform coverage of the site. The grid design was based on common practice for investigations of typical former landfill sites. Figure 4-3 illustrates the proposed sampling design at Anomaly Area 3.

4.2.7.1 AIR

Air samples will be collected to assess the potential emissions from the surface of the waste. Integrated surface air sampling and ambient air sampling will be used at Anomaly Area 3.

TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHOD FROM AERIAL PHOTOGRAPHY DATED NOVEMBER 8, 1990 BY AIRBORNE SYSTEMS, INC.



LEGEND

	MINOR SURFACE ELEVATION: 2-FOOT INTERVALS
460	MAJOR SURFACE ELEVATION: 10-FOOT INTERVALS
	MCAS EL TORO BOUNDARY
	EXISTISTING STREAM OR WASH
	ESTIMATED EXTENT OF WASTE PLACEMENT
	GENERAL GROUNDWATER DIRECTION
HA31	PROPOSED SOIL/SOIL VAPOR SAMPLING LOCATIONS
TR05	PROPOSED TRENCH LOCATION
MW06	PROPOSED GROUNDWATER MONITORING WELL LOCATION
CPT01	PROPOSED CONE PENETROMETER TEST LOCATION
PG01	PROPOSED PERIMETER GAS MONITORING WELL LOCATION
MW4	EXISTING GROUNDWATER MONITORING WELL
PZ3	EXISTING VADOSE ZONE WELL

NOTE:

1. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL.
2. SURFACE WATER WILL BE COLLECTED FROM AGUA CHINON WASH AT ONE LOCATION UPGRADIENT AND ONE LOCATION DOWNGRADIENT FROM ANOMALY AREA 3, TO BE DETERMINED DURING OBSERVED SURFACE WATER FLOW.

NORTH

60 0 60 120 FEET

SCALE: 1"=120'

RSE Work Plan — Final

Proposed Sampling Locations

Removal Site Evaluation for Anomaly Area 3

Date: 08-02	MCAS El Toro	Figure
Project No. 37380	EARTH TECH A tyco INTERNATIONAL LTD. COMPANY	4-3

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Integrated surface sampling follows South Coast Air Quality Management District (SCAQMD) guidance for waste sampling (SCAQMD 1989). Anomaly Area 3 has been divided into 50,000 square foot grids to facilitate integrated surface sampling. Approximately eight air samples will be collected from these eight 50,000 square foot grids for analysis. The walk pattern that will be adopted for collecting the integrated air samples will meet the requirements of the SCQAMD Rule 1150.1. All samples containing more than 50 ppmv total organic carbon as methane will be submitted to the laboratory for analysis. If all samples screened are below 50 ppmv, at a minimum, the two samples with the highest concentrations will be sent to the laboratory for analyses.

Ambient air sampling will be conducted at the perimeter of the waste to assess the potential impact of the waste emissions on the surrounding air quality and will meet the requirements of SCQAMD Rule 1150.1. The sampling will be conducted in the upwind and downwind direction of the waste. Air samplers will be placed at the perimeter of the waste at three locations, one upwind and two in the downwind direction and operated for two 12-hour periods (three locations times two events for a total of six samples). The ambient air samples collected within the site and at the perimeter will be sent to the laboratory to be analyzed by EPA Method TO-14 for VOCs and fixed gases (including methane).

4.2.7.2 Soil Vapor

Shallow and subsurface soil vapor sampling will be conducted across Anomaly Area 3 to characterize soil vapors within the waste and determine whether soil hot spots are present. If soil hot spots are present, a landfill gas collection system will be implemented. Perimeter subsurface soil vapor sampling will be conducted to verify whether any vapor is migrating to and beyond the boundaries of the waste.

An initial round of shallow vapor sampling will be conducted on a 100-foot by 100-foot grid, which is expected to identify a circular hot spot having a radius of 50 feet or greater. If a sample location shows evidence of contamination, then soil vapor samples will be collected from a 50-foot by 50-foot grid, which is expected to adequately characterize the hot spot. Each vapor sample will be collected from the center of the grid. Soil vapor samples will be collected at each sampling location at a depth of 5 feet and 15 feet bgs. Approximately 76 samples will be collected from the landfill and analyzed for VOCs and methane.

Perimeter soil vapor samples will be collected from the existing vadose zone probes (PZ1, PZ2, and PZ3) and also from the newly constructed perimeter soil vapor monitoring wells (PG1, PG2, and PG3). Samples will be screened with a field instrument equipped with a photoionization detector (PID). Four quarterly sampling events will be conducted.

The location, number, design, and installation of the vapor monitoring wells will meet the requirements of Title 27 CCR, Section 20925. At each location, the vapor monitoring wells will be installed at depths to coincide with the shallow zone, intermediate zone, and the zone at or near the greatest depth of the waste. Figure 4-3 shows sample locations.

4.2.7.3 Soil

The principal objective of soil sampling will be to collect adequate data to complete a screening-level human health and ecological risk evaluation and for assessing engineering properties for evaluating the existing soil cover at Anomaly Area 3.

Soil Samples for Risk Assessment. Soil samples will be collected from the locations of direct push borings advanced during soil vapor sampling (i.e., centers of 100-foot by 100-foot grid blocks). Thirty-eight surface soil samples will be collected from 0–0.5 feet depths using a hand auger and/or a

California split-barrel sampler. All samples collected will be analyzed for Title 22 metals, VOCs, SVOCs, and petroleum hydrocarbons. Previous soil sampling data indicate that the soil dioxin/furan concentrations were below the residential and industrial PRGs; however, 25 percent of the surface soil samples (0–0.5 feet bgs) collected will be analyzed for dioxins/furans to obtain a more representative characterization. Samples for dioxin analysis will be evenly distributed among the selected locations for surface soil samples.

Subsurface soil samples (8-9 feet bgs) will be collected only if the soil vapor sample at the 5-foot depth has detected concentrations of target analytes. Sampling will continue at 10-foot intervals to the base of the fill if analysis shows reportable concentrations of target analytes. Figure 4-3 shows sample locations.

Soil Samples for Geotechnical Analysis. Five samples will be collected from the surface soil for geotechnical characterization. The data will support the design criteria for final static and seismic stability and settlement of the final cover system and grading of the site. Geotechnical laboratory testing will include classification, index, and engineering properties. Engineering property testing will include shear strength of in situ onsite material, as well as hydraulic conductivity testing.

Classification and index property testing for onsite materials will be performed to provide grain-size distribution (American Society of Testing and Materials [ASTM] D 422 and D 1140), Atterberg limits, (ASTM D 4318), moisture content (ASTM D2216), specific gravity (ASTM D854), and in situ dry density (ASTM D 2937).

Engineering property testing of the existing cover as a potential foundation layer for a new cover system will include compaction characteristics of foundation layer soil materials (ASTM D 1557). Testing of soluble sulfates and soluble chlorides in soils, pH, and resistivity (California Department of Transportation [DoT]) 417, 532, 643) will be performed to develop recommendations for protection against the corrosion potential of buried metallic utilities and aggression of sulfate soils to concrete structures.

To evaluate the properties of soil in and around Anomaly Area 3, up to eight cone penetrometer test (CPT) soundings will be advanced. Data collected will be used for stability evaluation.

4.2.7.4 SEDIMENT SAMPLING

Sediment samples will be collected to evaluate whether Agua Chinon Wash has been impacted by the waste. As a part of this investigation, four sediment samples (at upstream and downstream locations) will be collected from the wash within the waste placement boundary. The sediment samples will be analyzed for the same suite of analyses as the soil samples for risk assessment.

4.2.7.5 GROUNDWATER

Six groundwater wells are proposed for this investigation. Groundwater samples will be collected from all four monitoring wells (MW1, MW2, MW3, and MW4) and the newly constructed wells (MW5, MW6, MW7, MW8, MW9, and MW10) shown on Figure 4-3. Water level measurements will be recorded in the monitoring logs during monitoring. These levels will assist in documenting and confirming groundwater levels and the hydraulic gradient at the site. The collected samples will be analyzed for petroleum hydrocarbons, VOCs, SVOCs, metals, and Perchlorate. Individual target analytes are presented in Appendix A.

4.2.7.6 LEACHATE

Because groundwater is at approximately the same level as the lowest elevation of waste, the installation of lysimeters to evaluate leachate generation is not practical. Therefore, the potential release of contaminants from the waste to the groundwater will be evaluated using the groundwater monitoring well network.

4.2.7.7 SURFACE-WATER

Surface water samples will be collected to assess whether the wastes have impacted the surface water. Sampling of surface-water runoff will be attempted from two locations near Anomaly Area 3 at Agua Chinon Wash during three storm events. The proposed sampling locations are designed to evaluate analyte concentrations in surface water at the upstream end and at a downgradient location within Agua Chinon Wash. As with groundwater, surface runoff samples will be analyzed for the full suite of analyses and compared to groundwater quality criteria. Surface water samples will also be collected during two rainfall events when runoff from Anomaly Area 3 is observed to flow into Agua Chinon Wash.

5. RISK EVALUATION

Analytical data will be used in a PRE of human health and in an ecological PRE. The human health and ecological PREs will be conducted according to current Navy methodology. The human health PRE will follow the draft *PACDIV Risk Assessment Protocols* (Earth Tech 1999)

5.1 HUMAN HEALTH PRE

A human health PRE will be performed to assess whether potential receptors are impacted by site contamination and whether contamination poses a significant risk to human health. The PRE will be conducted according to the *EPA Risk Assessment Guidance for Superfund (RAGS)* (EPA 1989 and 1991) and Navy PACDIV protocol (Earth Tech 1999). The human health PRE will be conducted in two phases. First, a conservative "screening" PRE will be performed using EPA Region 9/Cal-EPA modified PRGs (EPA 2000b) as the basis of comparison; and second, if necessary, a site-specific PRE will be performed making appropriate modifications to the CSM and/or exposure assumptions to refine the risk estimates. Figures 5-1, 5-2, and 5-3 show the PRE decision tree, which is discussed below.

5.1.1 Complete Exposure Pathways

The PRE is only intended to address complete or potentially complete exposure pathways under more generic land use scenarios (i.e., residential and industrial). The *RAGS* (EPA 1989) defines a complete or potentially complete exposure pathway as one that is

- A source and mechanism of a chemical release,
- A retention or transport mechanism in or through an environmental medium,
- A point of potential human contact with the contaminated medium (exposure point), and
- An exposure route (i.e., ingestion, dermal, or inhalation) at the exposure point.

The exposure pathway will be considered incomplete if any of these elements is missing.

The screening PRE will be used to evaluate the potentially complete exposure pathways asscociated with the potential ingestion, dermal contact, and inhalation of contaminants in surface and subsurface soil by future residential and industrial receptors at the site. Modifications of presumed exposure conditions will be addressed in the site-specific PRE.

The approach used for the screening and site-specific PRE is discussed below.

5.1.2 Screening PRE

Exposure point concentrations (EPCs) for media of concern will be determined consistent with guidelines established by EPA (1992) *Calculating the Concentration Term*. Both maximum (Max) and reasonable maximum exposure (RME) EPCs will be calculated. The maximum EPC is defined as the maximum detected concentration of a constituent of concern and will be used to place an upper boundary on the risk associated with potential exposure to a COPC. The RME EPC (defined by the EPA as "the highest exposure that is reasonably expected to occur at a site"- [EPA 1989]) will be either statistically determined as the 95 percent upper confidence limit on the arithmetic mean, assuming either a normal or log-normal distribution based on data set characteristics, or the maximum value, whichever of the two is lower. Figure 5-1 presents the specific approach used for the screening PRE. While these steps will be completed essentially with the generation of the summary statistics table, they are individually listed below for clarity.

1. Calculate summary statistics consistent with the CSM for all data including Max and RME EPCs for all detected concentrations.
2. Compare the maximum detected concentration (Max EPC) to residential PRGs.
3. If no Max EPCs exceed the residential PRGs, no further action will be recommended and the risk evaluation will conclude.
4. If Max EPCs exceed the residential PRGs, compare the Max EPCs to the industrial PRGs.
5. If Max EPCs do not exceed the industrial PRGs, no further action will be recommended for an industrial land use scenario.
6. For all detected chemicals, exclusive of lead, calculate the cumulative cancer risk and the non-cancer hazard index (HI) based on the Max and RME EPCs.
7. Compare the Max and RME lead EPC to residential and industrial PRGs and determine if the EPCs exceed the PRGs. If so, proceed to the site specific PRE.
8. If the RME EPC-based cancer risk for the applicable land use scenario is less than $1x10^{-6}$, and the RME EPC based HI is less than 1.0, no further action with be recommended for the specific land use scenario evaluated.
9. If the risk and/or the HI are greater than their respective acceptable levels, proceed to the site-specific PRE.

The RME risks and HIs will represent the benchmarks for determining whether remedial actions are necessary for the protection of human health.

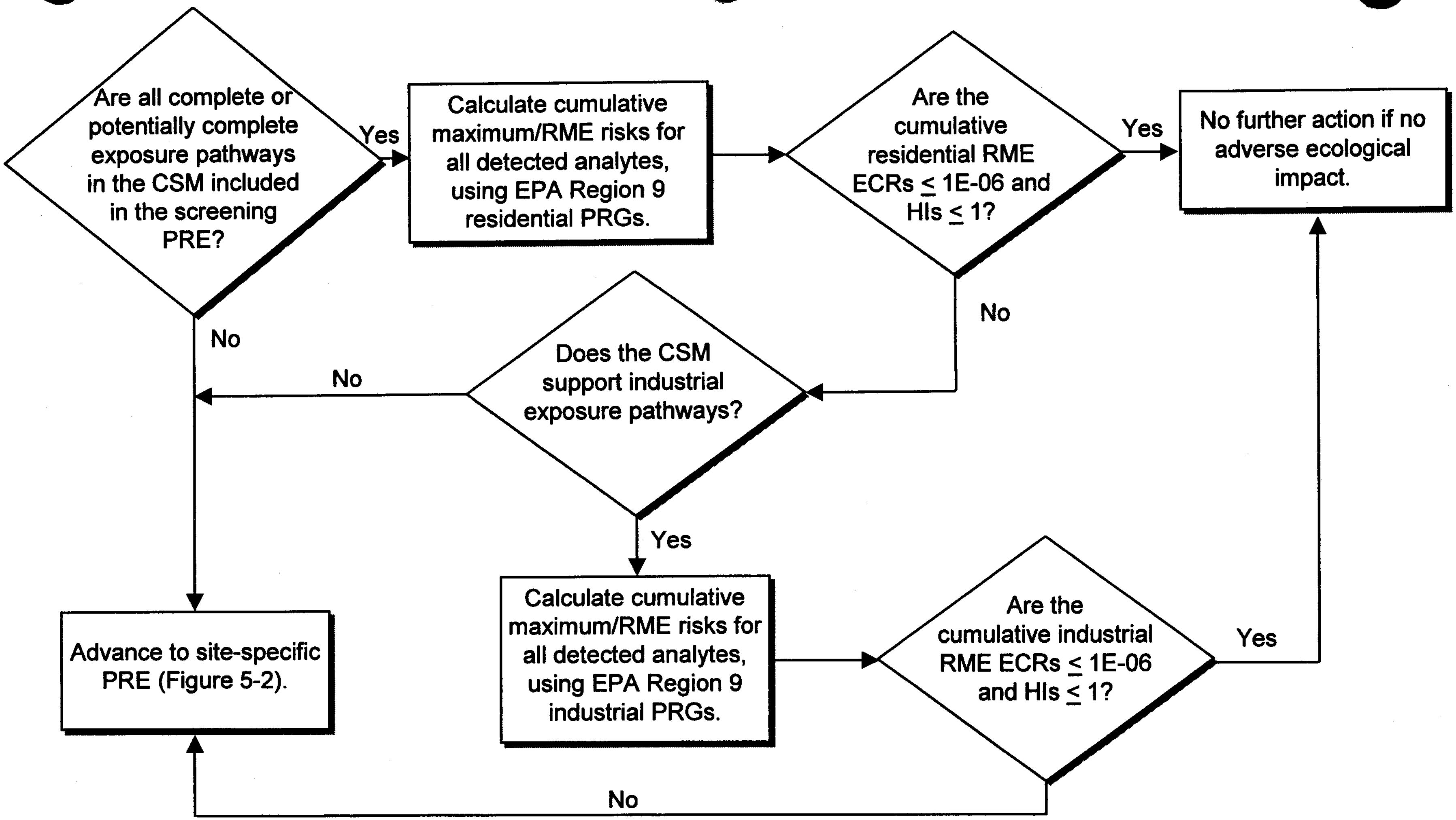
For evaluation of the groundwater pathway, soil and groundwater data will be evaluated separately. Constituents in soil will be compared to EPA Region 9 (Cal-EPA modified) SSLs to assess the potential for transfer to and exposure via groundwater. At this stage, risk associated with the soil constituents potentially impacting the groundwater pathway will not be determined but will be noted for subsequent evaluation in the site-specific PRE. Correspondingly, groundwater data will be compared to the Region 9 PRGs for tap water or the federal/California MCLs to determine the potential risk to receptors via the groundwater pathway, assuming hypothetical potable use of this medium.

Because no PRGs or SSLs exist for non-residential or non-industrial land use scenarios (i.e., current and future agricultural workers, future construction workers), a site-specific PRE will be performed for these classes of receptors, using acceptable toxicity values and exposure factors as decision criteria.

If maximum and RME EPCs for lead exceed the EPA Region 9 residential or industrial PRGs (as appropriate), then a site-specific PRE will be performed, and blood lead levels in receptors of concern will be modeled to determine the potential for adverse health effects posed by lead.

5.1.3 Site-Specific PRE

As with the screening PRE, the RME risks and HIs relative to acceptable levels will represent a point of departure for determining whether further risk evaluation is necessary for the protection of human health. If the screening PRE suggests adverse health effects may occur, then a site-specific PRE will be performed to derive more site-specific estimates of risk. The site-specific PRE will be designed to



Notes:

ECR	excess cancer risk
HI	hazard index
PRG	preliminary remediation goal
RI	remedial investigation
RA	risk assessment
RME	reasonable maximum exposure
CSM	conceptual site model
PRE	preliminary risk evaluation

Figure 5-1
Human Health Screening Preliminary Risk Evaluation Decision Tree (for all chemicals except lead)
Draft Work Plan-Removal Site Evaluation
Anomaly Area 3, MCAS El Toro, California

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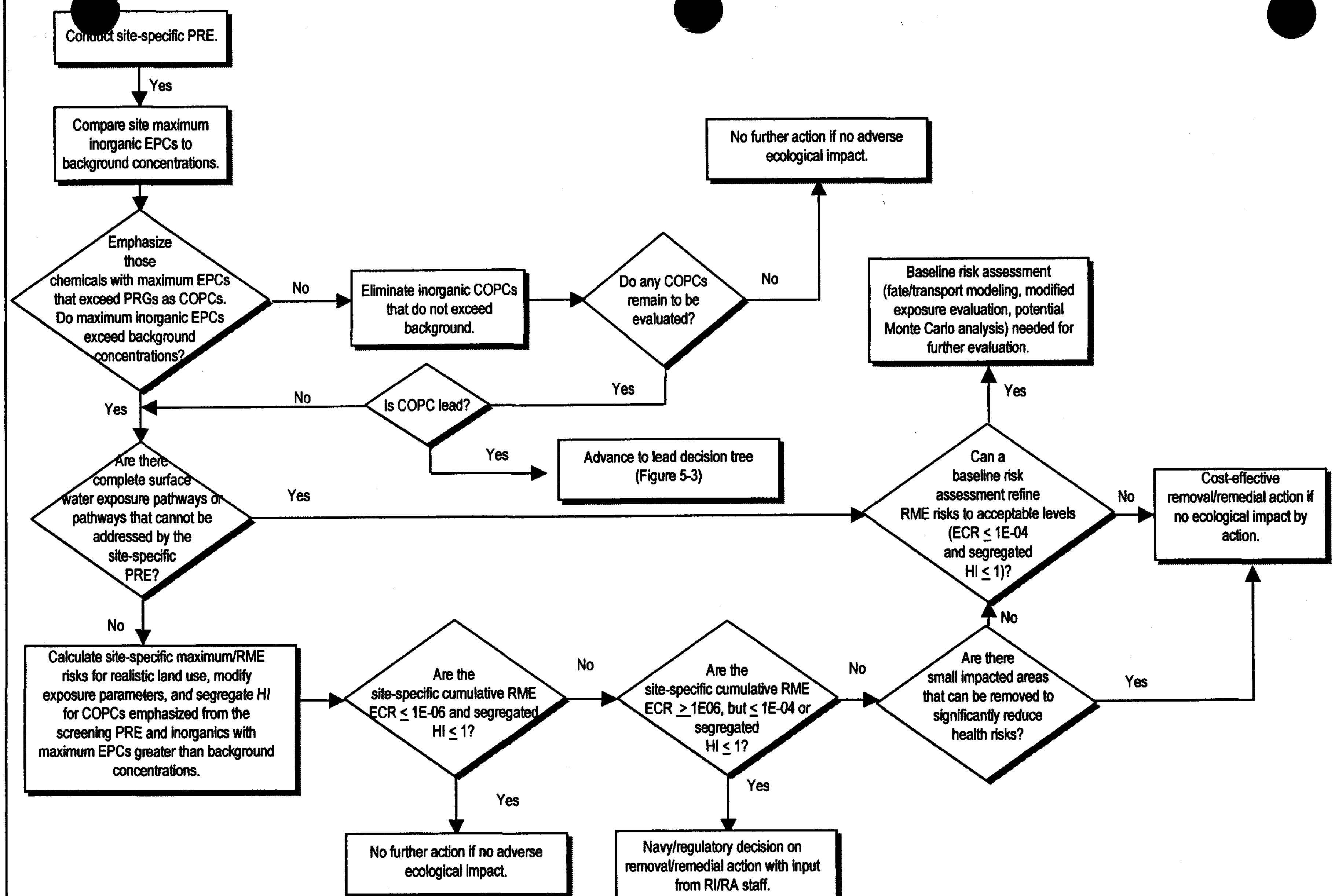

Notes:

ECR	excess cancer risk	
HI	hazard index	
PRG	preliminary remediation goal	
RI	remedial investigation	
EPC	exposure point concentrations	
RA	risk assessment	
RME	reasonable maximum exposure	
CSM	conceptual site model	
PRE	preliminary risk evaluation	

Figure 5-2
Human Health Site-*Specific* Preliminary Risk Evaluation Decision Tree (for all chemicals except lead)
Draft Work Plan-Removal Site Evaluation
Anomaly Area 3, MCAS El Toro, California

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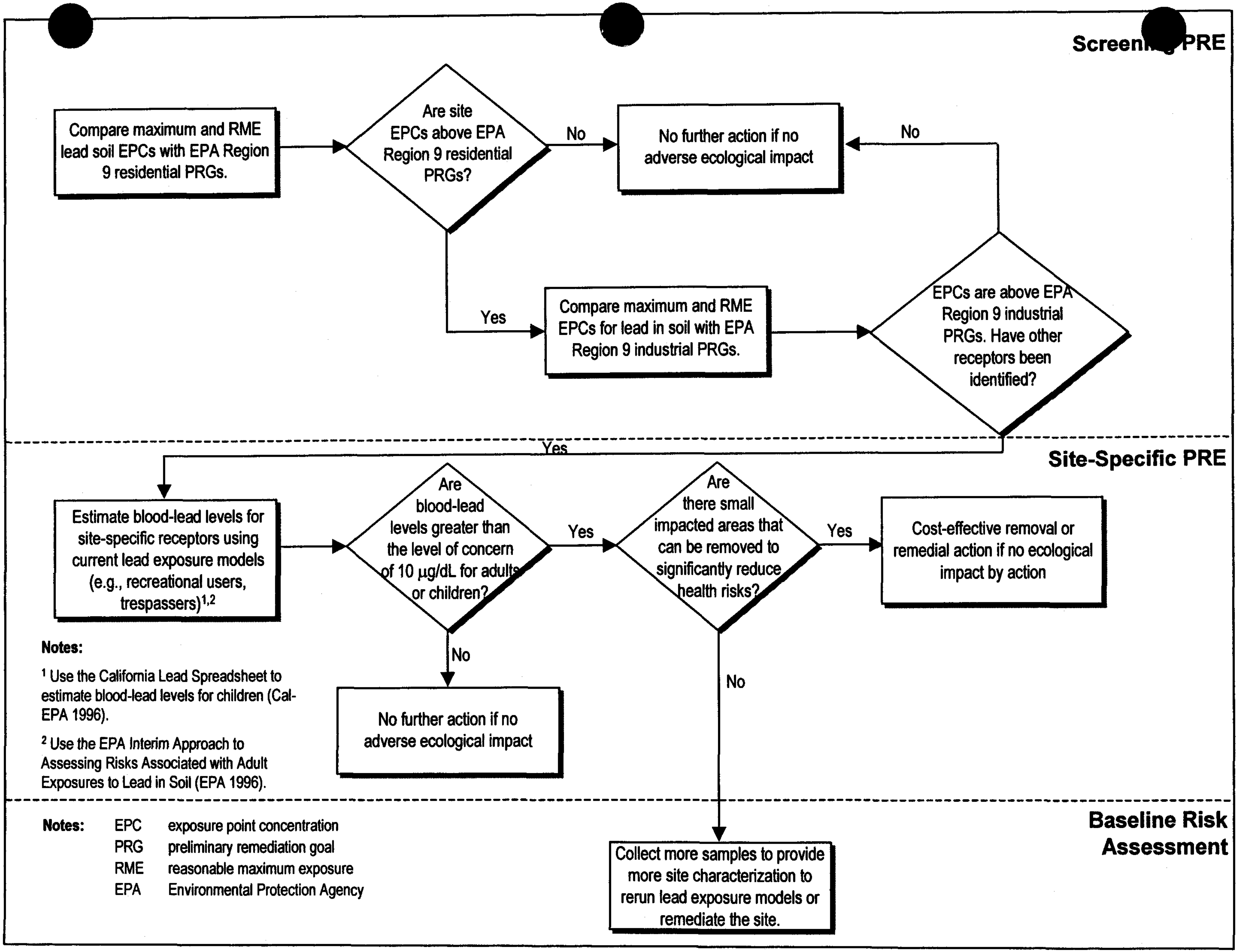

Figure 5-3
Human Health Preliminary Risk Evaluation Decision Tree for Lead
Draft Work Plan-Removal Site Evaluation
Anomaly Area 3, MCAS El Toro, California

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evaluate pathways, receptors, and intake rates that are not accounted for in the generic Region 9 PRGs or SSLs. For example, after performing the PRE, potential revisions of the conceptual site model may warrant inclusion of receptors (e.g., construction workers, trespassers, utility workers, agricultural workers) or exposure pathways (e.g., incidental contact with groundwater employed for other than potable uses) that were not anticipated in the formulation of the PRE. Thus, if subsurface soil concentrations exceed SSLs or industrial soil PRGs, a site-specific PRE may be performed to evaluate the risk or non-cancer hazard to the construction worker receptor group because SSLs and PRGs do not consider this receptor group. The site-specific PRE will differ mainly in that it will generally identify only exposure factors (i.e., frequencies, durations) for these receptors to determine differential COPC intake and potentially site-specific risk for RME. This will ensure that a reasonably consistent approach will be used for all receptors. If other exposure factors warrant modification, the rationale supporting such modifications will be presented.

If site groundwater is found to potentially pose an unacceptable risk or non-cancer hazard to receptors evaluated in the site-specific PRE, the investigation will be augmented with an additional phase of study followed by revision to the risk assessments.

For detected chemicals that are both site-related and associated with excess risk such that the individual chemical-specific risk makes a substantial contribution to the cumulative risk calculated in the screening PRE, the site-specific PRE will include organic and inorganic COPCs as appropriate. Organic COPCs with maximum detected concentrations greater than medium-specific SSLs or PRGs will be retained in the site-specific PRE. Concentrations for inorganic COPCs, (i.e., metals) will be compared against background/non-site-related concentrations to determine if inorganic materials are likely site-related. Metals with concentrations that do not exceed background levels will be flagged as potentially naturally occurring but will still be included in the evaluation of risk and non-cancer hazard as COPCs. If the data indicate that excess risk is associated with metals at levels that are naturally occurring, additional evaluation of the background conditions may be required. Such an evaluation is likely to consist of confirmation that background values are indeed representative of naturally occurring conditions but may involve additional sampling and analyses. Prior to conducting any additional sampling and analyses, appropriate regulatory agencies will be consulted regarding the intended objectives and proposed approaches.

If the site-specific cumulative RME health risks are at or below an excess cancer risk (ECR) of 1E-06 and an HI of 1, then no further action will be recommended. If the site-specific cumulative RME ECR is between 1E-06 and 1E-04, then the most cost-effective action will be recommended. If the site-specific cumulative RME health risks slightly exceed an ECR of 1E-04 and an HI of 1 and there are no isolated, impacted areas where a small removal action could adequately reduce health risks, then a baseline risk assessment will be recommended. If the site-specific cumulative RME risk values are an order of magnitude or more above the levels appropriate for remediation and a baseline risk assessment cannot refine the risk estimates to acceptable levels, then a remedial or removal action (e.g., capping or excavation and removal of contaminated soil) will be recommended if it does not cause an unreasonable impact to the site ecology.

5.2 ECOLOGICAL PRE

The ecological PRE will be conducted in accordance with federal (EPA 1997b) and Navy (DoN 1999) guidance for conducting screening ecological risk assessments (SERA). Ecological receptors such as small mammals and birds may be exposed to soil contamination by ingestion of contaminated food and soil. The PRE is a two-step process. First, a conservative Tier I SERA will be performed using conservative assumptions and toxicity reference values developed by the DoN in cooperation with EPA and DTSC (EFAW 1997). Second, if necessary, a site-specific Tier 2, Step 3a baseline environmental risk assessment (BERA) will be performed using refined, site-specific exposure assumptions. Because ecological SSLs do not exist for terrestrial ecological receptors, they require development from existing information.

The SERA will be conducted in accordance with the following guidance:

- *EPA Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, Interim Final *(RAGS)* (EPA 1997c).
- *Navy Policy for Conducting Ecological Risk Assessments* (DoN 1999)
- *Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites* (EPA 1999c)
- *Tri-Services Procedural Guidelines for Ecological Risk Assessments* (Wentsel et al. 1996)

Figure 5-4 illustrates the EPA's eight-step ecological risk assessment process for Superfund (EPA 1997c). Figure 5-5 presents the Navy's cost-effective three-tiered approach to ecological risk assessment, which combines a tiered approach with EPA's eight-step process.

5.2.1 Screening PRE

A screening PRE (or SERA) is conducted in two steps (EPA Steps 1 and 2 [Figure 5-4]:

Step 1, Screening Level Problem Formulation. The first step of the SERA is to determine what biological resources are present at the sites and to evaluate existing site information. It includes, but is not limited to, the following tasks:

- Performance of biological site reconnaissance;
- Description of ecological setting of the sites and surrounding area, listing of plants and animals, and identification of threatened and endangered species and habitats of special concern;
- Identification of COPECs;
- Performance of exposure pathway analysis;
- Development of a biological CSM;
- Establishment of assessment and measurement endpoints;
- Development of soil screening concentrations for terrestrial ecological receptors.

The problem formulation component of the SERA leads to one of two outcomes: (1) dismissing a site from further investigation if there are no site-related contaminants or significantly exposed biota; or (2) proceeding with the SERA to identify potential risks that require further evaluation.

Step 2, Screening Level Exposure Estimate and Risk Characterization. The second step of the SERA is to estimate the intake (dose) and calculate preliminary risks. This step involves (1) estimating potential exposure to site COPECs, using information on exposure pathways and species natural history to model intake (dose) of contaminants in various site media by terrestrial species; and (2) comparing the potential exposure value to toxicological benchmark values potentially associated with adverse effects to representative species. If the exposure value exceeds the benchmark value, then the potential exists for adverse effects to the receptor of concern. Step 2 includes the following:

- Development of species-specific and chemical-specific exposure parameters,
- Comparison of exposure point concentrations to conservative species-specific soil screening values,
- Presentation of uncertainty analysis,
- Characterization of risk.

The Tier 1 SERA can lead to three possible outcomes:

1. The site passes the SERA based on conservative exposure assumptions. A determination is made that the site poses acceptable risk and shall be recommended for closure based on ecological concerns.
2. The site fails the SERA, and potential risks are not extreme. The site must have both complete exposure pathways and unacceptable risk. If the potential risks are not extreme, a refinement of the conservative exposure assumptions may reduce the estimated risk to acceptable levels. After a scientific management decision point (SMDP), move to a site-specific PRE (Tier 2, Step 3a of the Navy three-tiered approach) and refine risk exposure model assumptions.
3. The site fails the SRA and the potential risks are high. If it is obvious that refinement of the risk model assumptions will not reduce the estimated risk to an acceptable level, an accelerated site remediation is indicated. After an SMDP meeting with EPA, refine exposure assumptions and develop site-specific ecological risk-based cleanup goals.

5.2.2 Site-specific PRE

If a site does not pass the conservative SERA, then a site-specific PRE (also referred to as Tier 2, Step 3a) will be performed to estimate more realistic levels of risk. The site-specific PRE focuses on only those COPCs that are not screened out in the initial screening process. It reevaluates and refines all assumptions to ensure that they are more realistic and applicable to the site, considering special characteristics and biological resources at the site. Refinements may include, but are not limited to

- Comparison of concentrations of inorganics to background concentrations,
- Refinement of exposure assumptions,
- Refinement of exposure point concentrations (use of 95 percent upper confidence limit [UCL] in place of maximum soil concentration),
- Final comparison of exposure point concentrations to screening concentrations,
- Calculation of screening level risk and interpretation of adverse effects in light of uncertainties.

If the initial refinements do not reduce the estimated risks to acceptable levels, a further BERA should be proposed. The results of the BERA will be used to further quantify risk and to calculate site-specific ecological risk-based cleanup goals.

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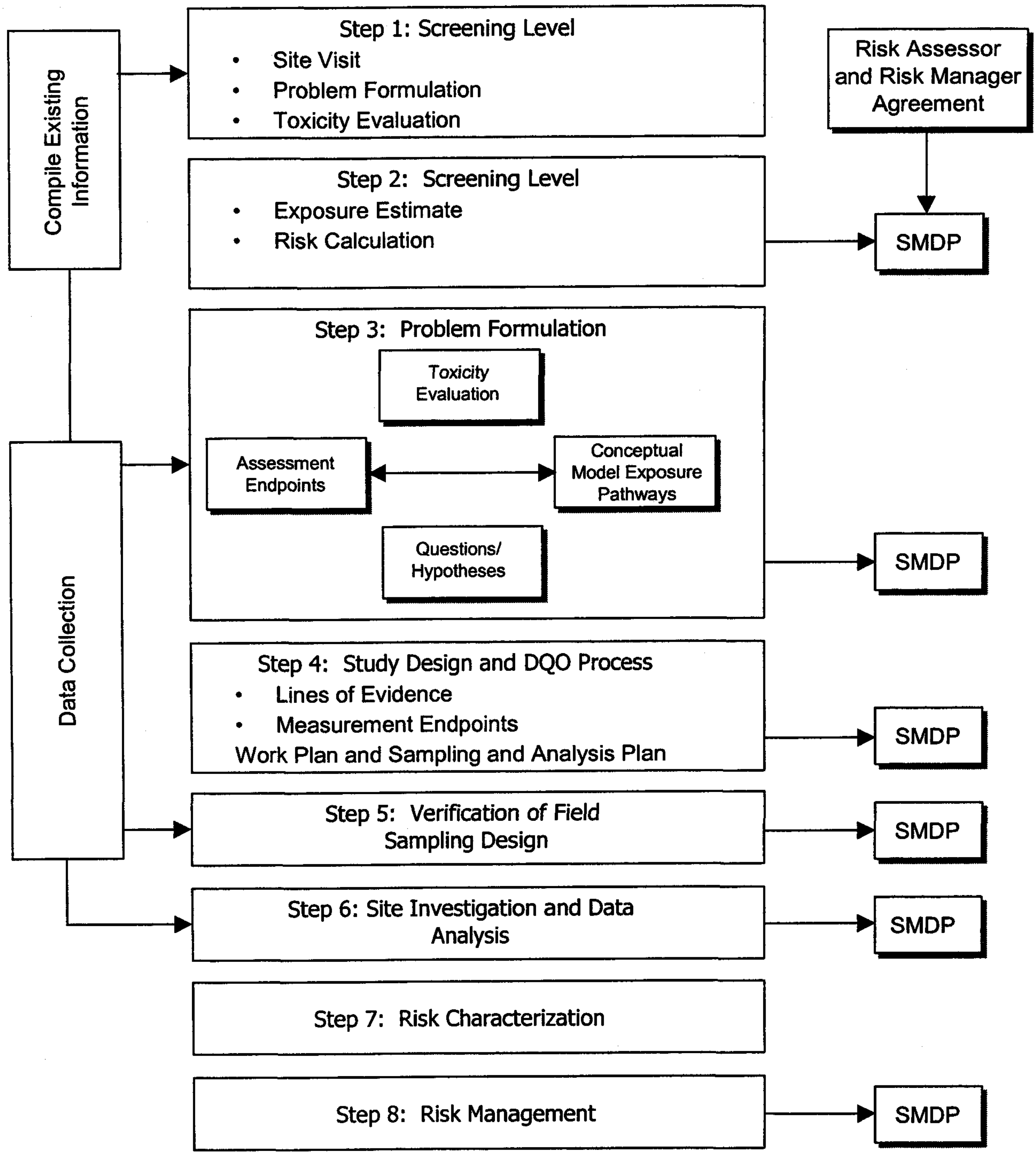

Notes:
SMDP = *scientific management decision point*
DQO = data quality objectives

Figure 5-4: Eight-Step Ecological Risk Assessment Process for Superfund

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RPM Input and Risk Management Consideration[3]

Step 8: Risk Management

Tier 1. Screening Risk Assessment (SRA): Identify pathways and compare exposure point concentrations to bench marks.

Step 1: Site visit, Pathway Identification/Problem Formulation; Toxicity Evaluation

Step 2: Exposure Estimate; Risk Calculation (SMDP)[1]

Proceed to Exit Criteria for SRA

Exit Criteria for the Screening Risk Assessment: Decision for existing or continuing the ecological risk assessment.

1) Site passes screening risk assessment: A determination is made that the site poses acceptable risk and shall be closed our to ecological concerns.

2) Site fails screening risk assessment: The site must have both complete pathway and unacceptable risk. As a result the site will either have an interim cleanup or moves to the second tier.

Tier 2. Baseline Ecological Risk Assessment (BERA): Detailed assessment of exposure and hazard to "assessment endpoints" (ecological qualities to be protected). Develop site specific values that are protective of the environment.

Step 3a: Refinement of Conservative Exposure Assumptions[2] (SRA)--- **Proceed to Exit Criteria for Step 3a**

Step 3B: Problem Formulation - Toxicity Evaluation; Assessment Endpoints; Conceptual Model; Risk Hypothesis (SMDP)

Step 4: Study Design/DQO - Lines of Evidence; Measurement Endpoints; Work Plan and Sampling & Analysis Plan (SMDP)

Step 5: Verification of Field Sampling Design (SMDP)

Step 6: Site Investigation and Data Analysis [SMDP]

Step 7: Risk Characterization

Proceed to Exit Criteria for BERA

Exit Criteria Step 3a Refinement

1) If re-evaluation of the conservative exposure assumptions (SRA) support an acceptable risk determination then the site exits the ecological risk assessment process.

2) If re-evaluation of the conservative exposure assumptions (SRA) do not support an acceptable risk determination then the site continues in the Baseline Ecological Risk Assessment process. **Proceed to Step 3b.**

Exit Criteria Baseline Risk Assessment

1) If the site poses acceptable risk then no further evaluation and no remediation from an ecological perspective is warranted.

2) If the site poses unacceptable ecological risk and additional evaluation in the form of remedy development and evaluation is appropriate, proceed to third tier.

Tier 3. Evaluation of Remedial Alternative (RAGs C)

a. Develop site specific risk based cleanup values.

b. Qualitatively evaluate risk posed to the environment by implementation of each alternative (short term) impacts and estimate risk reduction provided by each (long-term) impacts; provide quantitative evaluation where appropriate. Weigh alternative using the remaining CERCLA 9 Evaluation Criteria. Plan for monitoring and site closeout.

Notes: 1) See EPA's 8 Steps ERA Process for requirements for each Scientific Management Decision Point (SMDP).

2) Refinement includes but is not limited to background, bioavailability, detection frequency. etc.

3) Risk Management is incorporated throughout the tiered approach.

Figure 5-5: Three-tiered Navy Approach to Ecological Risk Assessment

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Appendix A
Sampling and Analysis Plan

Appendix A
Sampling and Analysis Plan
Final Work Plan
Removal Site Evaluation
Anomaly Area 3
MCAS El Toro, California

Contract No. N62742-94-D-0048
Contract Task Order No. 0078

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CONTENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

ASTM	American Society of Testing and Materials
BCT	BRAC Cleanup Team
CIWMB	California Integrated Waste Management Board
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
COC	chain of custody
COPC	chemical of potential concern
CPT	cone penetrometer test
CRWQCB	California Regional Water Quality Control Board
CTO	contract task order
DoN	Department of the Navy
DoT	California Department of Transportation
Earth Tech	Earth Tech, Inc.
EDDs	electronic data deliverables
ELAP	California State Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
EWI	Environmental Work Instructions
HSA	hollow-stem auger
HSP	health and safety plan
ICP	inductively coupled plasma
ID	identification
IDW	investigation-derived waste
IRCDQM	Navy Installation Restoration Chemical Data Quality Manual
LCS	laboratory calibration sample
MCAS	Marine Corps Air Station
ml/min	milliliters per minute
MS	matrix spike
MSA	master services agreement
MSD	matrix spike duplicate
MSL	mean sea level
NEDTS	Naval Environmental Data Transfer System
NFESC	Naval Facilities Engineering Service Center
NPL	National Priorities List
PACNAVFACENGCOM	Pacific Division, Naval Facilities Engineering Command
PE	performance evaluation
PID	photoionization detector
PPE	personal protective equipment
ppmv	Parts per million by volume
PVC	polyvinyl chloride
QAO	quality assurance officer
QAPP	quality assurance project plan
QC	quality control
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RPD	relative percentage of difference
RPM	remedial project manager
RSE	removal site evaluation
SAP	sampling and analysis plan
SCAQMD	South Coast Air Quality Management District
SOP	standard operating procedure

SOW	statement of work
SWDIV	Naval Facilities Engineering Command, Southwest Division
U.S.	United States
USCS	United Soil Classification System
WHO	World Health Organization

A-1. INTRODUCTION

This sampling and analysis plan, which consists of a field sampling plan and a quality assurance project plan, was prepared for the removal site evaluation (RSE) for Anomaly Area 3 at the former Marine Corps Air Station (MCAS), El Toro, California.

This work plan was prepared by Earth Tech, Inc. (Earth Tech) on behalf of the United States (U.S.) Department of the Navy (DoN), Southwest Division, Naval Facilities Engineering Command (SWDIV), as authorized by the U.S. Navy, Pacific Division, Naval Facilities Engineering Command (PACNAVFACENGCOM) under Contract Task Order (CTO) number 0078 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) II program, contract number N62742-94-D-0048.

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A-2. FIELD SAMPLING PLAN

A-2.1 SAMPLING OBJECTIVES

Data gathering objectives for the RSE investigation include

- Installation of perimeter vapor monitoring wells;
- Installation of groundwater monitoring wells;
- A cone penetration test (CPT) survey;
- Air sampling (integrated and ambient) to evaluate the impact of the waste on air quality;
- Soil vapor (shallow and subsurface) sampling to verify whether soil vapor hot spots are present and to evaluate the need for a landfill gas collection system;
- Soil vapor (perimeter) sampling to verify whether soil vapor is migrating from the subsurface soil to the perimeter of the waste;
- Soil sampling (surface) and analysis for chemicals of potential concern (COPCs) to aid in the evaluation of human health risk;
- Geotechnical soil testing to evaluate the soil index and engineering properties of the foundation soil;
- Groundwater sampling to evaluate impact to groundwater and evaluation of the hydraulic gradient by water level measurements;
- Evaluation of the impact of the waste on Agua Chinon Wash by collecting sediment samples from the wash;
- Surface water sample collection from Agua Chinon Wash to evaluate impact to surface water;
- Verification of currently demarcated waste placement boundaries by trenching;
- A land survey for coordinates of trenches, soil vapor and soil sampling locations, and perimeter vapor and groundwater monitoring well locations.

A-2.2 FIELD METHODS AND PROCEDURES

Fieldwork will be performed in accordance with applicable CLEAN standard operating procedures (SOPs) (BNI 1999). Earth Tech field personnel will have copies of all referenced SOPs during the fieldwork. Any necessary significant modifications ordeviations (e.g., changes in equipment, materials, or deletion of a procedural step) will first be discussed with the CTO manager, the CLEAN program quality manager, and the Navy remedial project manager (RPM). Approved CLEAN SOPs were submitted to the BRAC Cleanup Team (BCT) by SWDIV. Copies of the SOPs can be provided to reviewers of this document, if requested.

A-2.2.1 Intrusive Sampling Clearance

Project personnel will perform an evaluation of records prior to preliminary field marking of the sampling locations. The evaluation will include available site plans, utility layouts, construction of as-built drawings, and results of previous subsurface investigations. A geophysical clearance survey of the sampling locations will be conducted prior to soil and soil vapor sampling, drilling, excavation, and well installation.

A-2.2.2 Drilling of Boreholes

Soil boreholes will be advanced using direct-push, CPT, or hollow-stem auger (HSA) techniques to assess the underlying geologic materials, to collect soil and soil vapor samples from within the waste for chemical and geotechnical analyses, and to install monitoring wells.

The division of the boreholes is as follows:

- Fifty-five boreholes in total
- Thirty-eight of 55 will be advanced using a direct-push rig and will be within the extent of the waste to facilitate the soil and soil vapor sampling
- Three of 55 will be HSA boreholes at the waste perimeter; these will be converted to perimeter vapor collection wells
- Six of the 55 will be HSA boreholes converted to groundwater monitoring wells
- Eight of the 55 boreholes at the waste perimeter for CPT

A-2.2.3 Monitoring Well Installation

Six new groundwater wells will be installed as part of this investigation. Well location surveys will be conducted by a California-registered land surveyor to determine horizontal locations to the nearest 0.1 foot and vertical locations to the nearest 0.01 foot (referenced to mean sea level [MSL]). The vertical elevation will be surveyed at a notch cut in the top of the well casing, typically on the north side of the well. All groundwater level measurements will also be made from this reference point.

Boreholes that will be used to install the groundwater monitoring wells will be drilled using an HSA to total depths at least 10 feet below the seasonal groundwater table.

Soil samples will be collected every 5 feet during drilling solely for field screening and lithologic description. Samples will be collected in accordance with CLEAN SOP 4, Soil Sampling (BNI 1999). The lithology will be described in accordance with the Unified Soil Classification System (USCS) as specified in Borehole Logging (BNI 1999).

The field manager will prepare records for the wells that detail the timing, amount of materials, and methods of installation and construction while installation is in progress. These records will be kept in a hardbound field notebook that will be forwarded to the CTO manager. At the time of construction, an as-built drawing will be prepared detailing the location and amounts of all materials used in the construction of each monitoring well. Records will be filled out with indelible ink. Construction records will include the date, time, and quantities of materials used at each stage. A complete listing of the stages of construction is provided in CLEAN SOP 5, Monitoring Well Installation and Development (BNI 1999).

A-2.2.3.1 Perimeter Vapor Monitoring Well Installation

- Vapor monitoring wells will be constructed in accordance with California Integrated Waste Management Board (CIWMB) requirements set forth in Title 27, Division 2, Section 20925 and the SCAQMD Rule 1150 compliance plan.
- Boreholes will be converted to triple-completion, 1-inch diameter perimeter monitoring wells, depending on the depth to groundwater.
- Schedule 40 polyvinyl chloride (PVC) casing will be used. The screen slot size will be 0.02 inches, and the filter pack will be # 3 Monterey sand. The filter pack will extend at least 1.0 foot above each screened interval. A bentonite seal will be placed above the filter pack. Concrete grout will be placed above the uppermost bentonite seal and will continue to ground surface. The anticipated screened interval ranges and lengths are listed in Table A-2-1. Actual screened intervals will be selected based upon lithologies encountered during drilling. Screens will be designed to discreetly segregate varied lithologies wherever possible, allowing for representative sample collection through diverse permeability ranges.
- Vapor monitoring wells will be completed above ground using an 8-inch diameter lockable anodized aluminum well monument with a concrete pad placed around the monument.

Additional crash protection, if required, will be provided by installing four concrete-filled, 4-inch diameter steel crash posts around the wells.

- All equipment will be decontaminated before each use in accordance with CLEAN II SOP 11, Decontamination of Equipment (BNI 1999).

Table A-2-1: Proposed Perimeter Vapor Well Specifications

Well ID	Diameter		Estimated Screen Depth (feet)
PG1	1-inch	Triple casing	5–6 13–14 20–30
PG2	1-inch	Triple casing	5–6 13–14 20–30
PG3	1-inch	Triple casing	5–6 13–14 20–30

A-2.2.3.2 Perimeter Vapor Monitoring Well Sampling

A minimum of four rounds of sampling is planned for Atmospheric Gases (including methane) and target volatile organic compounds (VOCs), in accordance with the methods and analyte lists presented in section A-3.2.2. The sampling procedures will be as follows:

- Samples will be collected using a vacuum pump and pre-evacuated Summa canisters or Tedlar bags for laboratory analyses.
- A site-specific purge volume versus sample concentration test using a mutligas meter (GA 90) will be initially performed to evaluate the appropriate volume of vapor to be purged from each casing prior to sample collection.

Well casings will be purged of the requisite volume at a flowrate of 100 milliliters per minute (ml/min). The vacuum pump will be removed and the Summa canister attached to the sampling port, or the pump will be used to collect the vapor sample in a Tedlar bag. The valve will be opened and the canister filled from the sample port.

After the first two sampling events, only those samples with photoionization detector (PID) readings above 25 parts per million by volume (ppmv) will be submitted for laboratory analysis for VOCs.

A-2.2.3.3 GROUNDWATER MONITORING WELL INSTALLATION AND CONSTRUCTION

- Wells will be constructed in accordance with CLEAN SOP 5, Monitoring Well Installation and Development (BNI 1999).
- The well casing will consist of 4.0-inch inside diameter (4.3-inch outside diameter) sections of blank schedule 40 PVC, flush-threaded, blank casing connected to a 4-inch diameter, schedule 40 PVC, 0.020-inch slotted screen. The well screen will extend approximately 5 feet above and 10 feet below static water level.
- The filter pack will be placed from the total depth of the borehole to approximately 2 feet above the screened interval. The filter pack will be inserted to minimize chances of bridging and will consist of clean, 20–40-size quartz sand or equivalent nonreactive filter pack material.
- The well will be surged to allow the filter pack to settle. Filter pack material will be added as required to allow the filter pack to extend to at least 2 feet above the screened interval of the well.
- A bentonite well seal (a minimum of 3 feet thick) will be placed immediately above the filter pack. Bentonite will be added in chip or pellet form and will be hydrated with approximately 5 gallons of clean water. The remaining annular space between the borehole sidewall and outer casing will be grouted using a mixture of cement and 3 to 5 percent bentonite in accordance with CLEAN SOP 5, Monitoring Well Installation and Development (BNI 1999).
- The wellhead will be aboveground, completed with protective casing or monument installed around the top of the well casing within a cement surface seal. The monument will extend at least 18 inches above grade and 12 inches below grade, and will have at least 2 inches of clearance between the top of the well casing and the lid of the monument. A cement pad 2 feet long by 2 feet wide that gently slopes away from the well and is at least 3 inches deep will be constructed around the protective casing. The top of the well casing will have a slip cap or locking cap. The monument will be fitted with a case-hardened lock to prevent unauthorized entry.
- The grout will be allowed to set for at least 24 hours. The well will be developed in accordance with CLEAN SOP 5, Monitoring Well Installation and Development (BNI 1999).

A-2.2.3.4 GROUNDWATER MONITORING WELL DEVELOPMENT

Following construction and development, monitoring wells will be purged prior to groundwater sampling. Development of each well will be conducted in accordance with CLEAN SOP 5, Monitoring Well Installation and Development (BNI 1999). Following installation, measurements of total well depth and static water level will be taken with a tape measure equipped with an electronic product/water interface detector to an accuracy of 0.01 foot. Measurements and calculated total well volume will be recorded in each well development log. Following 24 hours of grout curing, the same measurements will be taken and entered into each well development log. Field equipment (e.g., pH meter, conductivity meter, and water level recorders) will be calibrated prior to use each workday and promptly serviced, if required, in accordance with manufacturer's instructions.

Each well will be developed using a Teflon bladder pump or PVC bailer, depending on the volume of fluid yielded by each well to be removed. If possible, a minimum of four well-bore volumes will be extracted to remove fine-grained materials and to promote the movement of formation waters into the wells. Specific conductivity, temperature, and pH will be monitored during well development to demonstrate that these properties are stabilized. These data will also be entered into each well development log.

A-2.2.3.5 GROUNDWATER MONITORING WELL SAMPLING

The physical and chemical properties listed in Table A-2-2 will be assessed in accordance with CLEAN SOP 8, Groundwater Sampling (BNI 1999). Water level measurements will be taken before purging the well or sampling.

Table A-2-2: Well Development Monitoring Parameters

Type of Data	Measurement Unit	Resolution
Conductivity	µmho (micro mhos)	±5 percent full scale
Dissolved oxygen	parts per million (ppm)	±0.5 ppm
Oxidation-reduction potential	millivolt (mV)	±10 mV
pH	standard units	±0.2
Static groundwater level	feet above mean sea level	±0.01 foot
Temperature	degrees Celsius (°C)	±1°C

Notes:
°C = degrees Celcius; mV = millivolts; ppm = parts per million

The field crew will collect groundwater samples from each well in accordance with CLEAN SOP 8, Groundwater Sampling (BNI 1999).

A-2.2.4 Cone Penetrometer Testing

Cone penetrometer testing will be performed to obtain stratigraphic information and depth-to-water information. Information obtained will aid in designing the screen intervals of the vapor probes and refining the conceptual site model regarding groundwater hydrology and contaminant pathways. Lithographic information will be inferred from the CPT output based on correlations involving cone tip resistance, sleeve resistance, and pore-water pressure. The inferred results of the CPT test will assist in the geotechnical analysis of Anomaly Area 3.

Eight CPT locations were selected, five near the Agua Chinon Wash and three near the downgradient fenced area. The CPT locations are shown on Figure 4-3 of the work plan.

A-2.2.5 Data Collection

A-2.2.5.1 AMBIENT AIR

Integrated surface sampling follows SCAQMD guidance for landfill sampling (SCAQMD 1989) and South Coast Air Quality Management District (SCAQMD) Rule 1150.1. The sampling program consists of walking through a course of approximately 2,600 linear feet over a 25-minute period with a portable sampling pump with the inlet of the pump placed 2 to 3 inches above the waste surface. A surface sample of approximately 8–10 liters will be collected from each grid. Each sample will be collected by filling a Tedlar bag and analyzing the contents of the bag for total organic carbon as methane, using a GA-90 landfill gas monitor. Samples containing more than 50 ppmv total organic carbon as methane will be submitted to the laboratory for analysis. If all samples screened are below 50 ppmv, at a minimum, the two samples with the highest concentrations will be sent to the laboratory for analysis. According to SCQAMD Rule 1150.1, sampling for integrated air samples should be conducted when the landfill is dry and when the average wind speed is 5 miles per hour or less, with speed determined on a 15-minute average.

Meteorological parameters will be measured to verify wind flow patterns and to ensure that SCAQMD wind-threshold criteria are met. Comparison of the downwind sample concentrations with the upwind sample concentrations assesses the effects of the waste emissions on the ambient air quality, and these ambient air sampling conditions would meet the SCQAMD guidance criteria. The ambient air samples collected during the two 12-hour periods will be sent to the laboratory to be analyzed by environmental Protection Agency (EPA) Method TO-14 for VOCs and for Atmospheric Gases by ASTM D-1946. The ambient air samples will be analyzed as shown in Table A-2-3.

Table A-2-3: Planned Ambient Air Sampling and Analysis Summary

Analysis	Integrated Air Samples
VOCs (TO-14)	2
Atmospheric Gases (ASTM D-1946)	2

Note:
VOCs = volatile organic compounds

A-2.2.5.2 SOIL VAPOR

Soil vapor samples will be collected at 38 locations at depths of 5 feet and 15 feet bgs, and perimeter soil vapor samples will be collected at 5 locations around Anomaly Area 3, as shown on Figure 4-3 of the work plan. Boreholes will be advanced with direct push equipment and samples will be collected in accordance with the SOP developed for this project (Attachment 1). The SOP is based on the California Regional Water Quality Control Board (CRWQCB), Los Angeles Region, *Interim Guidance for Active Soil Gas Surveys* (1997). The samples will be collected by advancing a probe to the desired depth and withdrawing a minimum of three tube volumes of gas. The probe is constructed to minimize infiltration of surface air, and a minimum volume of gas will be purged. During purging, a GA 90 landfill gas monitor will be used to monitor the purged gas. It is expected that subsurface gas will have elevated carbon dioxide and suppressed oxygen values, as well as detectable concentrations of methane. These parameters will be monitored and recorded to qualitatively evaluate whether the results are effected by surface air intrusion. The soil vapor samples will be analyzed as shown in Table A-2-4.

Table A-2-4: Planned Soil Vapor Sampling and Analysis Summary

Analysis	Shallow Soil Vapor Samples	Field Duplicate Shallow Soil Vapor Samples	Perimeter Soil Vapor Samples	Duplicate Perimeter Soil Vapor Samples	Total No. of Samples
VOCs (Modified 8260)	76	8	5	1	150
Methane (Modified 8015)	8	–	–	–	8

Note:
VOCs = volatile organic compounds

A-2.2.5.3 SOIL

Soil samples will be collected at 38 locations as shown on Figure 4-3 of the work plan. The samples will be collected using hand auger or direct-push techniques at depths of 0–0.5 feet at each location. If required, additional subsurface soil samples (about 8–9 feet bgs) will be collected based on concentrations detected during soil vapor sampling in the subsurface.

Samples will be collected in accordance with CLEAN SOP 4, Soil Sampling (BNI 1999). Table A-2-5 presents the sampling and chemical analysis summary.

An evaluation of the existing soil cover will be conducted during drilling of the boreholes for soil vapor samples. After collecting surface samples (0–0.5 feet) for the risk assessment, a continuous core will be collected from the borehole. The continuous core soil samples will be checked visually to determine the depth of the soil cover at the location. Continuous core samples will be collected at all locations where soil vapor samples are proposed.

Table A-2-6 provides the geotechnical soil sampling and analysis summary.

Table A-2-5: Planned Soil Sampling and Chemical Analysis Summary

		Number of Samples				
Analysis	Sampling Type	Field Samples	Field Duplicates	Field Blanks[a]	Equipment Rinsates[b]	Total
SVOCs	Shallow and subsurface soil sampling	38	5	1	6	54
	Sediment sampling	4				
VOCs	Shallow and subsurface soil sampling	38	5	1	6	54
	Sediment sampling	4				
Petroleum Hydrocarbons	Shallow and subsurface soil sampling	38	5	1	6	54
	Sediment sampling	4				
Dioxins	Shallow and subsurface soil sampling	9	2	1	3	19
	Sediment sampling	4				
Metals	Shallow and subsurface soil sampling	38	6	1	6	55
	Sediment sampling	4				

Notes:
[a] Assumes one field blank per water source used for the final decontamination rinse water.
[b] Based on predicted number of field days/shipping events.
SVOCs = semivolatile organic compounds
VOCs = volatile organic compound

Table A-2-6: Planned Soil Sampling and Analysis Summary for Geotechnical Analysis

Parameter/Test	Method	Total No. of Samples[a]
Grain-size Distribution	ASTM[b] D 422/D 1140	5
Atterberg limits	ASTM D 4318	5
Moisture content	ASTM D 2216	5
Specific gravity	ASTM D 854	5
Compaction	ASTM D 1557	5
In situ density	ASTM D 2937	5

Notes:
[a] Testing for engineering properties will require multiple tests (for different conditions such as density, confining pressure, and drainage) on the same sample.
[b] ASTM = American Society for Testing and Materials

A-2.2.5.4 GROUNDWATER/SURFACE WATER

Groundwater samples will be collected from monitoring wells shown on Figures 2-2 and 4-3 of the work plan. Surface water samples will be collected at locations described in Section 4.2.7.7 of the work plan, in accordance with CLEAN SOP 12, Surface Water Sampling (BNI 1999). The groundwater and surface water sampling and analysis summary is provided in the Table A-2-7.

Table A-2-7: Planned Groundwater and Surface Water Sampling and Analysis Summary

Analysis	Groundwater Samples	Surface Water Samples	Total No. of Samples
SVOCs	20	6	26
VOCs	20	6	26
Metals	20	6	26
General Chemistry	20	6	26
Petroleum Hydrocarbons (extractable/volatile)	20	6	26
Perchlorate	20	6	26

Notes:
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

A-2.2.6 Trenching

Trenches or potholes will be excavated at the currently established boundaries of Anomaly Area 3 to confirm and/or refine the extent of waste placement as delineated in Section 3.0 of the work plan. It is anticipated that each trench will be approximately 25 feet long, 3 feet wide, and 10 feet deep. Trench alignments will be measured with a Brunton or other compass and a standard 100-foot tape, to a resolution of ±0.5 foot. Trenches will be mapped to determine the limit of waste, if encountered, and subsequently backfilled with the excavated soil. Trench descriptions, including cross sections, will be recorded in a field trench log. Field personnel will identify the types of soil collected following CLEAN SOP 3, Borehole Logging (BNI 1999) and ASTM D 2487 and 2488. Trenches will be backfilled upon completion of logging. No trench will be left unattended or open overnight.

A-2.2.7 Surveying

Trenches will be located with a survey stake placed adjacent to the trench. The stake will be placed at the location of the observed lateral limit of waste delineated within the trench. The depth of the trench and refuse limit will be referenced to a point on the survey stake. Limits of refuse between test pits will be extrapolated using topographic data and field observations. A plan view of the horizontal limits will be prepared for use on design drawings.

Well location and soil borehole surveys will be conducted by a California-registered land surveyor for horizontal location to the nearest 0.1 foot, vertical location to the nearest 0.01 foot, and referenced to MSL. The vertical elevation will be surveyed at a notch cut in the top of the well casing, typically on the north side of the well.

A-2.2.8 Investigation-Derived Waste

Investigation-derived waste (IDW) consists of all materials that may be contaminated with constituents of concern during fieldwork. It is anticipated that the field investigation will generate nonhazardous wastes (based on prior investigations), including but not limited to the following:

- Soil
- Well development and purged groundwater
- Decontamination water
- Disposable personal protective equipment (PPE), sampling equipment, and miscellaneous debris encountered during the investigation

Investigation-derived waste will be properly classified, labeled, managed, and disposed in accordance with EPA guidance and CLEAN SOP 22, IDW Management (BNI 1999). If the IDW generated during sampling is determined to be regulated by the Resource Conservation and Recovery Act (RCRA), then RCRA storage, transportation, and disposal requirements may apply. In general, proper implementation of IDW procedures requires CTO managers, field managers, and their designees to perform the following tasks:

- Minimize IDW as it is generated.
- Segregate IDW by matrix and source location.
- Follow proper procedures for IDW drum handling and labeling.
- Prepare an IDW drum inventory.
- Update and report changes to the IDW drum inventory.

Soil, Decontamination Water, Well-Development Water, and Purged Groundwater. Soil cuttings from the boreholes will be placed in 55-gallon drums. Non-disposable sampling equipment, the backhoe bucket, and PPE will be cleaned and decontaminated between each sample or activity location in accordance with the procedures described in Section A-2.2.9. Decontamination water will be collected in troughs, buckets, or in a decontamination pit constructed on site. Collected decontamination water will be transferred daily into Department of Transportation (DoT)-approved 55-gallon drums. Drums containing liquid IDW will be left with a headspace of 5 percent by volume to allow for expansion of the liquid. The drums will be labeled with the date and the boring number in accordance with CLEAN SOP 22, Investigation Derived Waste Management (BNI 1999). Drums containing IDW will be inventoried daily, stored on pallets at a designated staging area, and covered with tarps. Upon completion of fieldwork, a final inventory of the drums will be conducted to ensure that they are labeled correctly and that all drums are present.

Disposable PPE and Sampling Equipment. If, based on the best professional judgment of the field manager, the PPE and disposable sampling equipment can be rendered nonhazardous after decontamination procedures, then this equipment will be collected in double plastic bags and disposed of off site as municipal waste. Equipment that is potentially contaminated will be stored in drums, labeled, inventoried, and disposed of as hazardous waste. All waste materials generated in the support zone are considered non-IDW trash and will be properly disposed of as municipal waste.

IDW Disposal Plan. A disposal contractor will dispose of all IDW within 90 calendar days of completing the fieldwork, in accordance with the CERCLA offsite policy. Should hazardous waste disposal be required, an IDW disposal plan will be prepared for appropriate screening, sampling, chemical analysis, and disposal of the waste. Based on the results of the preliminary assessment of the site, it is not anticipated that hazardous waste will be generated; therefore, an IDW disposal plan has not been prepared.

A-2.2.9 Equipment Decontamination

All nonconsumable equipment that comes into contact with potentially contaminated soil or groundwater will be decontaminated in accordance with CLEAN SOP 11, Decontamination of Equipment (BNI 1999). Equipment will be decontaminated by steam cleaning or by a non-phosphate detergent scrub, followed by fresh water and distilled or deionized water rinses. Decontamination will take place on pallets or on plastic sheeting. Clean equipment will be stored on plastic sheeting in an uncontaminated area. Equipment stored for an extended period will also be covered by plastic sheeting.

All consumable equipment (e.g., gloves, disposable bailers) and liquid and solid wastes (e.g., purged groundwater, decontamination water, and soil cuttings) will be treated as potentially hazardous and handled in accordance with the procedures prescribed in section A-2.2.8.

The field team (including the drilling crew) will perform personnel decontamination prior to leaving the work site at the conclusion of each workday, following procedures described in the *CLEAN Field Health and Safety Manual* (Earth Tech 1998).

A-2.2.10 Sample Containers and Preservation

Select air samples will be collected in Tedlar bags or Summa canister and analyzed for VOCs, using EPA Method TO-14 and Atmospheric Gases by ASTM D-1946. Samples in Tedlar bags will be analyzed no later than 72 hours after collection. Table A-2-8 and Table A-2-9 list the chemical parameters to be tested and the types of containers and preservation methods to be used. These may be modified to accommodate selected laboratory preferences, but will meet the essential requirements of the method.

Table A-2-8: Requirements for Soil Sample Preservation, Maximum Holding Time, and Containers

Analyte	Analytical Method(s)	Preservation	Maximum Holding Time	Number × Sample Container Type
Total Volatile Petroleum Hydrocarbons	SW5035A/ SW8015B	Cool to 4°C/frozen	48 hours[a] (14 days, when frozen)	Three pre-tared 40-ml VOC vials with reagent water.
Volatile Organic Compounds	SW5035A/ SW8260B	Cool to 4°C/frozen	48 hours[a] (14 days, when frozen)	Three pre-tared 40-ml VOC vials with reagent water.
Total Extractable Petroleum Hydrocarbons	SW3550B/ SW8015B	Cool to 4°C	14 days[b]/40 days[c]	One 16-oz glass jar or stainless steel liner with Teflon-lined lid/end caps
Semivolatile Organic Compounds	SW3550B/ SW8270C	Cool to 4°C	14 days[b]/40 days[c]	
Dioxins/furans	SW3550B/ SW8390C	Cool to 4°C	30 days	One 16-oz glass jar or stainless steel liner with Teflon-lined lid and end caps
Metals	SW3050B/ SW6010/7000	None	6 months[a] (28 days for mercury)	One 16 oz-glass jar or stainless steel liner with Teflon-lined lid and end caps
pH	SW9045C	Cool to 4°C	Immediately	

Notes:
°C = degrees Celsius
[a] From sample collection to analysis.
[b] From sample collection to extraction.
[c] From sample extraction to analysis.
Ml = milliliter

Table A-2-9: Requirements for Groundwater Sample Preservation, Maximum Holding Time, and Containers

Analyte	Analytical Method(s)	Preservation	Maximum Holding Time	Number × Sample Container Type[d]
Total Volatile Petroleum Hydrocarbons	SW5030B/ SW8015B	HCl to pH<2 Cool to 4°C	14 days[a]	Three 40-ml VOC w/ Teflon-lined septa
Volatile Organic Compounds	SW5030B/ SW8260B	HCl to pH<2 Cool to 4°C	14 days[a]	Three 40-ml VOC w/ Teflon-lined septa
Total Extractable Petroleum Hydrocarbons	SW3520C/ SW8015B	Cool to 4°C	7 days[b]/40 days[c]	Two 1-L amber glass
Semivolatile Organic Compounds	SW3520C/ SW8270C	Cool to 4°C	7 days[b]/40 days[c]	Two 1-L amber glass
Metals	SW3010A/ SW6010/700 0	HNO_3 to pH<2	6 months[a] (28 days for mercury)	1-L plastic
pH	SW9045C	Cool to 4°C	immediately	250-mL plastic

Notes:
°C = degrees Celsius
L = Liter; ml = milliliter
[a] From sample collection to analysis.
[b] From sample collection to extraction.
[c] From sample extraction to analysis.
[d] Sample container volumes may be modified to meet laboratory specific procedures.
HCl = hydrochloric acid
HNO_3 = nitric acid

A-2.2.11 Sample Packaging and Shipment

Sample lids and caps will be covered with custody seals. All samples will be recorded on chain-of-custody (COC) forms in accordance with CLEAN SOP 10, Sample Custody, Transfer and Shipment (BNI 1999). Samples will be shipped or delivered within 24 hours to allow the laboratory to meet holding times for analysis.

Two copies of the COC forms will be placed in an adhesive plastic pouch and taped to the inside of each sample cooler. The coolers will then be sealed with waterproof tape and labeled "Fragile," "This End Up" (or with directional arrows pointing up), and other appropriate notices. Coolers will also have custody seals placed on them to prevent tampering.

Upon receipt, the laboratory will sign and retain copies of the airbill. A list of analyses to be performed and a space to record sample condition upon receipt are located on the COC record. The laboratory representative will sign the COC form and record the temperature of the samples or cooler on the COC form and on the Sample Condition Upon Receipt form. All samples requiring preservatives will be checked by measuring pH upon receipt (except for VOC samples). In case of breakage or discrepancies between the COC form, sample labels, or requested analyses, the sample custodian will notify the laboratory project manager. A nonconformance report will be completed, and the project chemist will be notified within 24 hours. At the time of notification, a corrective action will be chosen. The sample custodian will enter the information into the laboratory system, and a log-in confirmation sheet will be sent to the project chemist within 48 hours. The laboratory will send the project chemist a written declaration of the samples in each sample delivery group.

Hazardous Materials Shipment. Hazardous materials, as defined by the DoT, are not expected in the course of this project. Shipment of soil samples is not expected to exceed the minimal quantities for hazardous materials handling. The field team leader has been trained to recognize hazardous or dangerous goods and will notify the CTO manager of such issues prior to shipping.

A-2.2.12 Sample Documentation

Sample containers will be labeled as follows:

1. Labels will be written in indelible ink with the following information:
   - Project name or identifier
   - EPA sample identification (ID) number
   - Date and time of collection
   - Initials of the person collecting the sample
   - Method number or name of analysis to be performed
   - Preservative (if applicable)
2. A label with adhesive backing will be affixed to each sample container.
3. The label will be covered with clear tape to further secure it to the container and to keep the ink from smearing.

EPA Sample ID Number. To facilitate data tracking and storage, all samples will be labeled with a five-character sample ID number, referred to as an EPA ID, in accordance with recordkeeping, sample labeling, and COC procedures. The ID number for Anomaly Area 3 is determined as follows:

LHzzz

Where,

L	The Long Beach Office
H	CTO 78, Anomaly Area 3, Removal Site Evaluation
zzz	Chronological number, starting with 001

For example, the EPA number "LH030" would represent the 30th sample collected for the MCAS El Toro, Anomaly Area 3 RSE project, a project managed by Earth Tech's Long Beach office. Quality control (QC) samples will be included in the chronological sequence. If a sample is lost during shipping, a replacement sample will be assigned a new EPA number. If different containers for the *same* sample are shipped to the laboratory on different days, a new EPA number must be assigned. All sample identification numbers will be recorded in field logs, records, and a database to ensure traceability of the sample to the designated location or site.

Samples will also be assigned an Earth Tech sample ID, which will be recorded in field logs and databases. A descriptive sample ID number will specify the location, sequence, matrix, and depth, as follows:

#-bbcc-dee-Dfff

Where,

#	IRP (or equivalent) site number (in this case AA3 for Anomaly Area 3)
bb	Sample matrix and type (see Tables A-2-10)
cc	Location number (alphanumeric, e.g., MW201, HA11)
d	Sample or QC identifier (see Table A-2-11)
ee	Chronological sample number from a particular sampling location (e.g., 01, 02, 03)
D	The letter "D," denoting depth
fff	Depth of sample in feet bgs. For field blanks and equipment rinsates, the depth field will contain the month and date of collection.

Table A-2-10: Character Identifiers

Identifier	Sample Type	Matrix
SS	Soil or Sediment	Soil
SG	Soil Vapor	Soil Vapor
GW	Groundwater Well	Water
SW	Surface Water	Water
QS	Field QC	Soil
QG	Field QC	Soil Vapor
QW	Field QC	Water

Table A-2-11: QC Identifiers

Identifier	QC Sample Type	Description
S	Normal Sample	All non-field QC samples
D	Duplicate	Sample duplicate or co-located sample (adjacent liners or locations)
E	Equipment Rinsate	Water
F	Field Blank	Water
X	Blind Spike	Performance evaluation sample

A-2.2.13 Quality Control Samples

Field quality control samples will be submitted in accordance with the referenced standard operating procedures. The results of the analysis will be evaluated in accordance with the quality assurance project plan (QAPP).

Field Duplicates. One field duplicate sample will be collected for every 10 samples during groundwater sampling. Soil duplicates will not be collected. Field duplicates will be assigned a unique EPA ID and Earth Tech ID number.

Field Blanks. A single field blank per water source will be collected to measure potential contamination resulting from the water used for the final rinse in the decontamination process.

Equipment Rinsates. Final rinse water from the decontamination process of reusable equipment will be poured through clean equipment, collected, and submitted for analysis of target analytes for that day.

Trip Blanks. Sample containers shipped to the site and returned to the laboratory will be accompanied by a trip blank. The trip blank will be prepared by the laboratory from certified organic-free water and shipped to the field. Each shipment of samples for VOC analysis will be accompanied by a trip blank, which will be labeled with a unique EPA ID number.

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A-3. QUALITY ASSURANCE PROJECT PLAN

The quality assurance plan for the investigation at Anomaly Area 3 at former MCAS El Toro has been prepared in accordance with the requirements and specifications of the following:

- U.S. Navy Engineering Command, Southwest Division, *Environmental Work Instructions* (EWI) (SWDIV 2001)

  EWI #1 "Chemical Data Validation" (November 2001)
  EWI #2 "Review, Approval, Revision, and Amendment of Sampling and Analysis Plans (SAPs)" (November 2001)
  EWI #3 "Laboratory Quality Assurance Program" (November 2001)

- *Navy Installation Restoration Chemical Data Quality Manual (IRCDQM)*, October 1999

A-3.1 PROJECT MANAGEMENT

The project is managed in accordance with the contract requirements and specifications in CTO no. 0078 of the CLEAN II program, contract number N62742-94-D-0048.

A-3.1.1 Task Organization

Tasks associated with the investigation are summarized in Table A-3-1 and described in the following subsections.

Table A-3-1: Task Summary

Data Review and Project Planning (SOW Task 1)	Field Activities (SOW Task 2)	Data Evaluation and Report Preparation (SOW Task 3)
Task 20 Project Planning	Task 30 Field Investigations	Task 50 Data Validation
Task 22 Work Plan	Task 46 Laboratory Analysis	Task 51 Data Evaluation
Task 23 Sampling and Analysis Plan	Task 46 Onsite Laboratory Analysis	Task 53 Risk Assessment
Task 24 Health and Safety Plan		Task 65 RSE Report Preparation
Meetings (SOW Task 4)	**Purchasing Support (SOW Task 5)**	**Project Management (SOW Task 6)**
Task 11 Regulatory Meetings	Task 12 Purchasing and Subcontract Administration	Task 10 Project Management
Task 42 BCT/RAB Presentation		

Notes:
BCT = BRAC Cleanup Team
SOW = statement of work
RAB = Restoration Advisory Board
RSE = removal site evaluation

A-3.1.1.1 DATA REVIEW AND PROJECT PLANNING

Existing data will be compiled and reviewed, and technical statements of work (SOWs) will be prepared. Planning documents, including a combined work plan and SAP, and a health and safety plan (HSP) have been prepared. Coordination and scheduling with subcontractors will be completed. Site access will be secured and pre-work meetings will be conducted.

A-3.1.1.2 FIELD ACTIVITIES

Soil, soil vapor, groundwater, surface water, and sediment samples will be collected in accordance with the plan presented in the field sampling portion of this document.

A-3.1.1.3 DATA EVALUATION AND REPORT PREPARATION

Project staff will review all laboratory reports for contract and method compliance and data usability. Laboratory data packages will be subject to independent, third party validation when the data will be used to assess human risk.

Data will be presented in a relational database, using the conventions and structure of the Naval Environmental Data Transfer System (NEDTS). Electronic data will be verified for consistency with hard copy laboratory data reports.

Data collected during fieldwork and pertinent previously reported data will be presented in an RSE report. The report will provide the analytical results and the human health risk evaluation and the results of the geotechnical assessment with recommendations for a further course of action.

A-3.1.1.4 MEETINGS

Earth Tech personnel will participate in periodic BCT/Restoration Advisory Board (RAB) meetings and provide technical support when applicable, including briefing packages and fact sheets documenting project progress.

A-3.1.1.5 PURCHASING SUPPORT

Materials, supplies, and subcontractor services will be procured, and subcontracts will be administered.

A-3.1.1.6 PROJECT MANAGEMENT

The CTO manager will coordinate with the RPM to ensure that project objectives are accomplished in a timely and effective manner. Monthly progress reports summarizing project status will be prepared.

A-3.1.2 Project Organization

The project organization chart (Figure A-3-1) identifies project team members.

Remedial Project Manager. Provides governmental oversight of technical issues for the project. Interfaces with the BCT, community representatives, and the contractor to meet project objectives.

Quality Assurance Officer (QAO). Provides governmental oversight of the contractor's QA program. Provides quality-related directives through the RPM. Has authority to suspend project execution if QA requirements are not adequately met.

BRAC Cleanup Team. Representatives from local, state, and federal regulatory agencies who provide input to the Navy.

CTO Manager. Responsible for day-to-day management of project budgets, staffing, deliverables, and schedule. Communicates with the RPM on technical issues.

CLEAN II Program Manager. Provides management oversight of execution of the task order in compliance with the program contract.

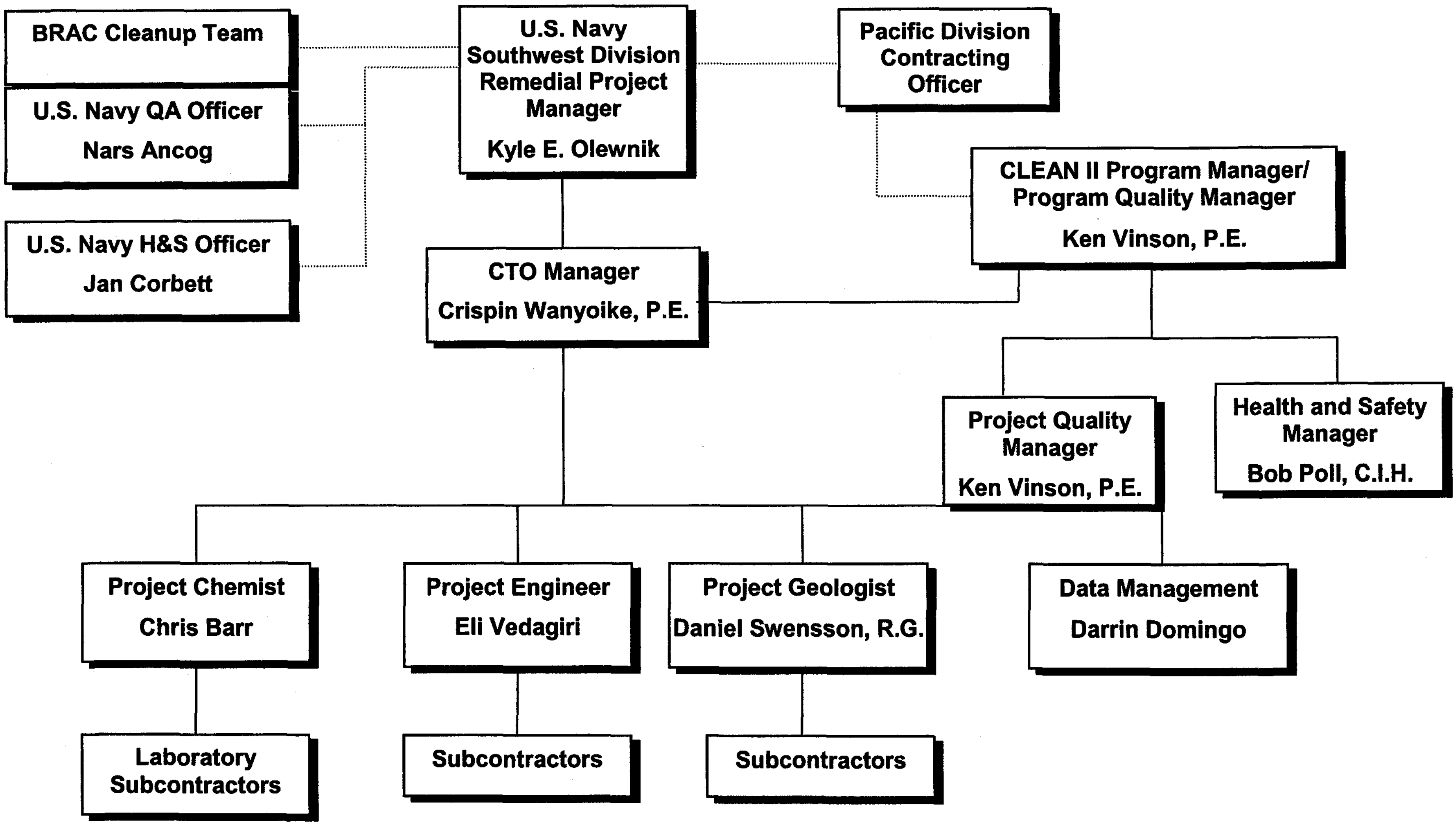

Figure A-3-1 Organization Chart

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Pacific Division Contracting Officer. Represents the government in all contractual, cost, and scheduling issues. Interfaces with RPM on performance and execution of the task order.

Program Quality Manager. Responsible for executing the contractor's QA program. Responsible for ensuring that technical standards and specifications are met for each deliverable to the client. Coordinates the peer and technical review of project deliverables and ensures standards and QA requirements are met.

Health and Safety Manager. Ensures that all field operations are conducted in accordance with safe operating practices and in compliance with federal and state requirements.

Project Chemist. Manages analytical laboratory services for the project. Prepares planning documents, technical specifications, and quality assurance plans for collection of data. Oversees technical performance of laboratory subcontractors.

Laboratory Subcontractor. Provides laboratory services in accordance with project specifications and subcontract statement of work.

Data Validation Subcontractor. Provides data validation services in accordance with project specifications and subcontract statement of work.

Project Geologist. Responsible for overseeing field operations that relate to groundwater, soil vapor and soil sampling, and evaluation of technical data. Oversees technical performance of subcontractors.

Project Engineer. Responsible for overseeing field activities and evaluating technical data in conjunction with the project geologist. Prepares planning documents for collection of data. Conducts data analysis and evaluation and prepares technical reports.

Special Training Requirements. Training requirements applicable to this project are as follows:

All field personnel will have current health and safety training in accordance with *CLEAN Health and Safety Manual* (Earth Tech 1998). This includes the initial 40-hour training and current 8-hour refresher training. The onsite health and safety manager will also have an additional 8 hours of supervisor training.

A-3.1.3 Schedule

The field investigation will span approximately 3 months. The schedule shown on Figure A-3-2 is for planning purposes only and will be revised as needed.

A-3.1.4 Data Quality Objectives

The EPA's seven-step DQO process (EPA 2000) has been followed to develop the work plan as discussed in section 4.2 of the work plan.

A-3.1.5 Documentation and Deliverables

Project records and documentation will be maintained in accordance with the procedures established for this program.

Field Documentation. Records will be kept in accordance with CLEAN SOP 17, Logbook Protocols (BNI 1999). Monitoring well location, design, and construction will be recorded in the field notebook for the CTO and on a Well Completion Record form. The field manager will provide a copy of the form to the CTO manager for the project files. The CTO manager will review all well construction logs.

In accordance with CLEAN SOP 17, Logbook Protocols (BNI 1999), a bound field notebook with consecutively numbered, water-repellent pages will be maintained. The logbook will be clearly identified with the name of the activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries. Data forms, with predetermined formats for logging field data, will be incorporated into the logbook. This logbook will serve as the primary record of fieldwork. Logbooks will allow a reviewer to reconstruct applicable events from entries made in chronological order and in sufficient detail. The logbook will be maintained in a clean area and used only when outer gloves have been removed. Entries on the data forms and in the logbook will meet the same requirements.

Entries will be made in indelible ink. Information recorded in the logbook will include the following:

- The logbook will reference data maintained in other logs.
- Corrections to entry records will be made by drawing a single line through the incorrect entry, initialing, and dating the change. An explanation will be included if more than a simple mistake is made.
- Entries will be signed or initialed by the individual making the entry at the end of each day.
- Page numbers will be entered on each logbook page.
- The preparer will photocopy completed pages weekly. The field manager will conduct a technical review of the logbook.

Laboratory Documentation. The laboratory will provide Level IV data packages for all results as required to perform validation in accordance with EPA guidance for data review (EPA 1994a and EPA 1994b). The packages will include a case summary, report forms, QC sample analysis results, acceptance criteria, calculations, chromatograms, and applicable bench logs and preparation notes. The laboratory will also provide data deliverables in a specified electronic format compatible with the project database, developed in compliance with NEDTS. All laboratory deliverables will be submitted within 30 calendar days of receipt of samples.

A-3.2 Measurement and Data Acquisition

All samples will be collected in accordance with Navy CLEAN II Program Procedures (BNI 1999), except as modified to meet project specific requirements and as presented in this QAPP.

A-3.2.1 Field Sampling Quality Assurance Measurements

Field sampling will include quality control samples that will characterize the contribution of sample collection and handling procedures on the results and provide an assessment of the quality of the data collected. The results of the quality assessment will be reflected in the conclusions and recommendations of the investigation. Quality control frequency will be in accordance with section A-2.2.13.

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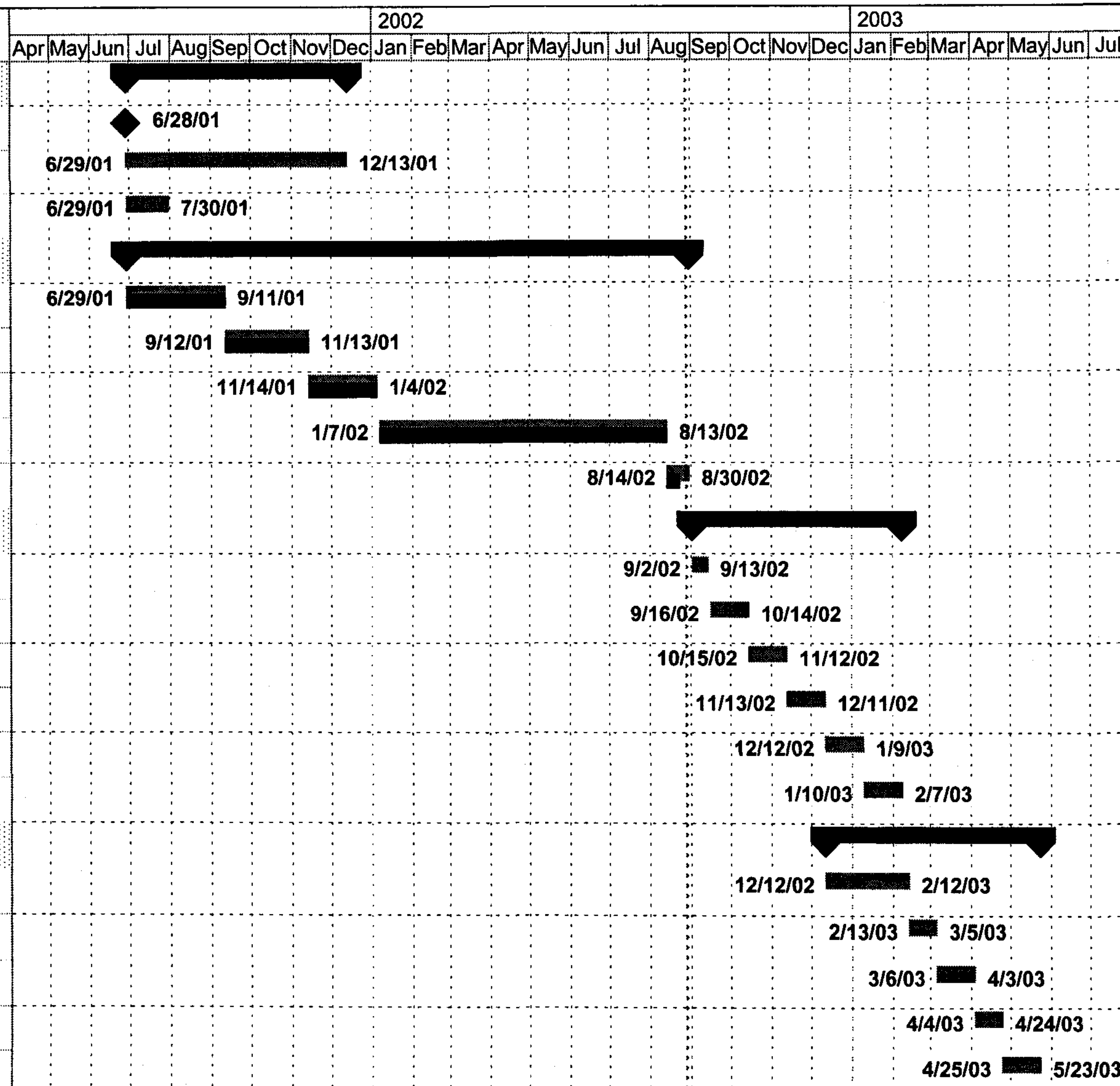
Figure A-3-2
Project Schedule
Final Work Plan - Removal Site Evaluation
Anomaly Area 3, MCAS El Toro

ID	Task Name
	Task 20 - Project Planning
2	Notice to Proceed
3	Finalize and Maintain Work Schedules
4	Prepare Technical SOWs
	Task 22 - Work Plan (WP)
6	Preliminary Draft RSE Work Plan
7	Navy Review
8	Draft RSE Work Plan
9	Navy and BCT Review
69	Final RSE Work Plan
	Task 30 - Field Investigation
11	Mobilization
13	Trenching
14	Soil Gas Evaluation
15	Monitoring Well Installation
16	Groundwater Sampling
12	Groundwater Baseline Sampling
	Task 65 - Removal Site Evaluation (RSE)
33	Prelim.Draft RSE Report
34	BCT Review
35	Prepare Draft RSE Report
36	Navy and BCT Review
37	Prepare Final RSE



Project: Anomaly Area 3
Print Date: Wed 8/28/02
Contract No: N62742-94-D004/CTO78

Task	Milestone	Project Summary
Progress	Summary	Group By Summary

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A-3.2.1.1 TRIP BLANKS

Trip blanks will be shipped with each package of samples submitted for analysis of volatile organic compounds. The trip blank will be submitted with a unique EPA ID and submitted for analysis. The results of the measurements will be used to assess the potential contribution of the shipping process to analytes found in the samples. Trip blanks with detectable concentrations of target analytes may be used to qualify the findings and results of associated samples.

A-3.2.1.2 TEMPERATURE BLANKS

A temperature blank will be submitted with each package in which samples are cooled and measured upon receipt at the laboratory. The acceptance criteria (4°C + 2) will be used to qualify the results of associated samples in accordance with applicable guidance.

A-3.2.1.3 FIELD DUPLICATES

Duplicate samples will be used to characterize the variability of the groundwater sampling process. Results will be compared to the laboratory variability criteria for laboratory duplicates to assess whether the effect is a function of laboratory sampling and analysis, a function of the sampling process, or a function of the inherent variability of the site. The qualitative assessment will be used to characterize the uncertainty of the conclusions of the investigation.

A-3.2.1.4 FIELD BLANKS

Field blank samples will be used to characterize any contribution from the water used for decontamination of equipment and may qualify the assessment of the results based on the equipment rinsates.

A-3.2.1.5 EQUIPMENT RINSATE BLANKS

Equipment rinsates will be collected to assess the potential contribution of cross contamination between sample locations to the results reported. Target analytes detected in equipment rinsates will be compared to analytes detected in samples and the conclusions qualified as necessary.

A-3.2.2 Laboratory Analytical Methods and Requirements

Laboratory services will be contracted under the Pacific Division Navy CLEAN II subcontracting system, which has master services agreements (MSAs) with Naval Facilities Engineering Service Center (NFESC)-evaluated (and approved) laboratories qualified to perform work for this project. The MSAs specify the work to be performed, which shall be done in accordance with the referenced method and the IRCDQM (NFESC 1999). For soil samples, the target analyte list is presented in Table A-3-2, and for groundwater samples it is presented in Table A-3-3.

A-3.2.2.1 VOLATILE ORGANIC COMPOUNDS

Volatile organic compounds will be analyzed in accordance with EPA Method 8260B, using sample collection and preparation in accordance with EPA 5035A for soil and 5030B for water. The analytes will be compounds on the contract laboratory program target list.

A-3.2.2.2 VOLATILE PETROLEUM HYDROCARBONS

Volatile hydrocarbons will be evaluated for the approximate carbon range C6 through C12, using purge and trap followed by gas chromatography. Samples will be collected and analyzed in accordance with EPA Method 8015B for soil and water.

A-3.2.2.3 EXTRACTABLE PETROLEUM HYDROCARBONS

Extractable hydrocarbons will be evaluated for the approximate carbon range C10 through C36, using extraction and gas chromatography. Samples will be collected and analyzed in accordance with EPA Method 8015B for soil and water.

A-3.2.2.4 SEMIVOLATILE ORGANIC COMPOUNDS

Samples will be analyzed for SVOCs in accordance with EPA Method 8270C. The analytes will be compounds on the contract laboratory program target list.

A-3.2.2.5 METALS

Samples will be analyzed for metals by trace inductively coupled plasma (ICP) EPA Method 6010, except where an alternative method will be needed to achieve the target reporting limits in the sample matrix. Samples will be analyzed for contract laboratory program (CLP) target list metals by SW6010 or 7000 series methods. Soils will be prepared in accordance with 3050B, and waters in accordance with 3010A.

A-3.2.2.6 DIOXINS AND FURANS

Samples will be analyzed for dioxins and furans in accordance with EPA Method 8290C. Target compounds will be analytes found in the World Health Organization (WHO) list of compounds (WHO 1997).

A-3.2.2.7 GENERAL CHEMISTRY

Groundwater samples will be analyzed for perchlorate by EPA 314.1. Samples will also be analyzed for pH by EPA SW9045C for soil and SW9040 for water.

A-3.2.2.8 VOLATILE ORGANICS IN SOIL GAS

Soil gas samples will be analyzed by modified SW8260 for volatile organic compounds. Analysis will be performed on site in a mobile laboratory in general accordance with the Los Angeles Regional Water Quality Control Board guidelines for *Active Soil Gas Investigations* (1997). The target analyte list for soil gas samples is presented in Table A-3-4.

A-3.2.2.9 METHANE IN SOIL GAS

Select soil gas samples will be analyzed by modified SW8015 for methane.

A-3.2.2.10 VOLATILE ORGANICS IN AMBIENT AIR

Select integrated ambient air samples will be analyzed by modified EPA Method TO-14 for volatile organic compounds. The target analyte list for ambient air samples is presented in Table A-3-4.

A-3.2.2.11 ATMOSPHERIC GASES

Selected air samples will be analyzed by ASTM Method D-1946 for atmospheric gases and methane.

A-3.2.3 Quality Control Requirements

All laboratory measurements will be performed in accordance with the Navy's *IRCDQM* (NFESC 1999) and the Earth Tech MSA. The laboratory is required to have an approved QA program with current SOPs for each method performed.

The laboratory will perform the following quality control analyses in accordance with the cited methods:

- Method or reagent blanks
- Matrix spikes
- Duplicates or matrix spike duplicates
- Surrogates
- Blank spikes or laboratory control samples

The values shown in Table A-6-2 will be used to validate the data and assess the acceptability for the project goals. Laboratory-derived acceptance criteria will be used if the criteria are either narrower than those presented in Table A-6-2, or if not, they will be developed in accordance with the published method to represent realistic operational criteria.

Table A-3-2: Project Quality Control Criteria for Soil Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Total Volatile Petroleum Hydrocarbons (Extraction: SW5035A; Analysis: SW8015B) (mg/kg)					
Volatile Petroleum Hydrocarbons	10	10	28	71–127	72–124
Total Extractable Petroleum Hydrocarbons (Extraction: SW3550B; Analysis: SW8015B) (mg/kg)					
Extractable Petroleum Hydrocarbons	10	10	50	50–149	51–134
Volatile Organic Compounds (Extraction: SW5035A; Analysis: SW8260B) (µg/kg)					
1,1,1,2-Tetrachlorethane	3,000	5	30	65–135	65–135
1,1,1-Trichloroethane	630,000	5	30	65–135	65–135
1,1,2,2-Tetrachloroethane	380	5	30	64–135	64–135
1,1,2-Trichloroethane	840	5	30	65–135	65–135
1,1,2-Trichlortrifluoroethane (F113)	5,600,000	5	50	50-150	50-150
1,1-Dichloroethane	590,00	5	30	62–135	62–135
1,1-Dichloroethene	54	5	29	69–127	71–125
1,2- Dichlorotetrafluoroethane (F114)	–	5	50	50-150	50-150
1,2-Dichloroethane	350	5	30	58–137	58–137
cis-1,2-Dichloroethene	43,000	5	30	65–135	65–135
trans-1,2-Dichloroethene	63,000	5	30	65–135	65–135
1,2-Dichloropropane	350	5	30	60–135	60–135
2-Butanone (MEK)	7,300,000	100	50	50–150	50–150
2-Hexanone	–	50	50	50–150	50–150
4-Methyl-2-pentanone (MIBK)	790,000	50	50	50–150	50–150
Acetone	1,600,000	100	50	35–165	35–165
Benzene	650	5	22	75–119	76–118
Bromodichloromethane	1,000	5	30	65–135	65–135
Bromoform	62,000	5	30	65–135	65–135
Bromomethane	3,900	5	30	62–135	62–135
Carbon disulfide	360,000	5	30	65–135	65–135

Table A-3-2: Project Quality Control Criteria for Soil Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Carbon tetrachloride	240	5	30	52–135	52–135
Chlorobenzene	150,000	5	21	75–125	76–116
Chloroethane	3,000	5	30	55–135	55–135
Chloroform	240	5	30	64–135	64–135
Chloromethane	1,200	5	30	65–135	65–135
cis-1,3-Dichloropropene	700	5	30	64–135	64–135
Dibromochloromethane	1,100	5	30	63–135	63–135
Dichlorodifluoromethane (F12)	94,000	5	50	50-150	50-150
di-Isopropyl ether (DIPE)	--	5	50	50-150	50-150
Ethyl tertiary butyl ether (ETBE)	--	5	50	50-150	50-150
Ethylbenzene	1,500,000	5	30	65–135	65–135
Methylene chloride	8,900	5	30	65–135	65–135
Methyl-tert-butyl ether (MTBE)	17,000	5	50	50-150	50-150
Styrene	4,600,000	5	30	65–135	65–135
Tertiary amyl methyl ether (TAME)	--	5	50	50-150	50-150
Tertiary butyl alcohol (TBA)	--	20	50	50-150	50-150
Tetrachloroethene	5,700	5	29	66–125	69–121
Toluene	590,000	5	21	72–126	72–126
trans-1,3-Dichloropropene	700	5	30	56–135	56–135
Trichlorfluoromethane (F11)	390,000	5	50	50-150	50-150
Trichloroethene	2,800	5	30	61–135	61–135
Vinyl chloride	150	5	30	36–144	36–144
Xylenes (total)	1,400,000	15	30	65–135	65–135
Semivolatile Organic Compounds (Extraction: SW3550B; Analysis: SW8270C) (µg/kg)					
1,2,4-Trichlorobenzene	650,000	500	61	10–132	40–116
1,2-Dichlorobenzene	900,000	500	30	32–135	32–135
1,3-Dichlorobenzene	13,000	500	30	26–135	26–135
1,4-Dichlorobenzene	3,400	500	57	15–128	38–116
2,2'-oxybis(1-Chloropropane)	2,900	500	30	36–135	36–135
2,4,5-Trichlorophenol	6,100,000	500	30	25–175	25–175
2,4,6-Trichlorophenol	44,000	500	30	29–138	29–138
2,4-Dichlorophenol	180,000	500	30	36–135	36–135
2,4-Dimethylphenol	1,200,000	500	30	35–149	35–149
2,4-Dinitrophenol	120,000	2,500	30	25–161	25–161
2,4-Dinitrotoluene	120,000	500	61	12–134	38–118
2,6-Dinitrotoluene	61,000	500	30	41–135	41–135
2-Chloronaphthalene	3,900,000	500	30	50–135	50–135

Table A-3-2: Project Quality Control Criteria for Soil Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
2-Chlorophenol	63,000	500	54	12–120	35–113
2-Methylnaphthalene	--	500	30	31–135	31–135
2-Methylphenol	3,100,000	500	30	25–135	25–135
2-Nitroaniline	3,500	2,500	30	40–135	40–135
2-Nitrophenol	--	500	30	34–135	34–135
3,3'-Dichlorobenzidine	1,100	500	30	25–175	25–175
3-Nitroaniline	--	2,500	30	41–135	41–135
4,6-Dinitro-2-methylphenol	--	2,500	30	25–144	25–144
4-Bromophenyl-phenylether	--	500	30	43–137	43–137
4-Chloro-3-methylphenol	--	500	58	10–126	37–113
4-Chloroaniline	240,000	1,000	30	35–146	35–146
4-Chlorophenyl-phenyl ether	--	500	30	41–142	41–142
4-Methylphenol	310,000	500	30	25–135	25–135
4-Nitroaniline	--	2,500	30	30–153	30–153
4-Nitrophenol	490,000	2,500	60	12–132	15–128
Acenaphthene	3,700,000	500	59	16–134	41–118
Acenaphthylene	--	500	30	37–135	37–135
Anthracene	22,000,000	500	30	35–175	35–175
Benzo(a)anthracene	620	500	30	41–143	41–143
Benzo(a)pyrene	62	25[d]	30	31–135	31–135
Benzo(b)fluoranthene	620	500	30	27–135	27–135
Benzo(g,h,i)perylene	--	500	30	25–159	25–159
Benzo(k)fluoranthene	6200	500	30	31–135	31–135
bis(2-Chloroethoxy)methane	--	500	30	39–135	39–135
bis(2-Ethylhexyl)phthalate	35,000	500	30	34–135	34–135
bis-(2-Chloroethyl)ether	210	163 (mdl)	30	25–139	25–139
Butylbenzylphthalate	12,000,000	500	30	25–135	25–135
Carbazole	24,000	500	30	25–159	25–159
Chrysene	62,000	500	30	45–143	45–143
Di-n-butylphthalate	6,100,000	500	30	40–135	40–135
Di-n-octylphthalate	1,200,000	500	30	42–135	42–135
Dibenz(a,h)anthracene	62	25[d]	30	27–135	27–135
Dibenzofuran	290,000	500	30	25–175	25–175
Diethylphthalate	49,000,000	500	30	25–136	25–136
Dimethylphthalate	610,000,000	500	30	28–137	28–137
Fluoranthene	2,300,000	500	30	37–135	37–135
Fluorene	2,600,000	500	30	38–149	38–149

Table A-3-2: Project Quality Control Criteria for Soil Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Hexachlorobenzene	200	500	30	36–143	36–143
Hexachlorobutadiene	6,200	500	30	25–135	25–135
Hexachlorocyclopentadiene	420,000	2,500	30	31–135	31–135
Hexachloroethane	35,000	500	30	25–163	25–163
Indeno(1,2,3-cd)-pyrene	620	500	30	25–170	25–170
Isophorone	510,000	500	30	25–175	25–175
N-Nitroso-di-n-propylamine	69	25[d]	30	40–135	40–135
N-Nitroso-diphenylamine	99,000	2,500	30	36–143	36–143
Naphthalene	56,000	500	30	27–135	27–135
Nitrobenzene	20,000	500	62	10–134	32–122
Pentachlorophenol	3,000	1,700	62	10–134	15–128
Phenanthrene	–	500	30	44–135	44–135
Phenol	3,700,000	500	53	10–116	30–111
Pyrene	2,300,000	500	56	22–134	38–130
Metals (Preparation: SW 3050B; Analysis: Mercury SW 7471, all other metals SW 6010) (mg/kg)					
Aluminum	14,800	5	20	75–125	80–120
Antimony	3.06	3	20	75–125	80–120
Arsenic	6.86	0.3	20	75–125	80–120
Barium	173	1	20	75–125	80–120
Beryllium	0.669	0.2	20	75–125	80–120
Cadmium	2.35	0.2	20	75–125	80–120
Calcium	46,000	10	20	75–125	80–120
Chromium	26.9	0.5	20	75–125	80–120
Cobalt	6.98	0.5	20	75–125	80–120
Copper	10.5	0.5	20	75–125	80–120
Iron	18,400	3	20	75–125	80–120
Lead	15.1	0.3	20	75–125	80–120
Magnesium	8,370	0.5	20	75–125	80–120
Manganese	291	10	20	75–125	80–120
Mercury	0.22	0.2	20	75–125	80–120
Nickel	15.3	0.2	20	75–125	80–120
Potassium	4,890	20	20	75–125	80–120
Selenium	0.32	0.3	20	75–125	80–120
Silver	0.539	0.5	20	75–125	80–120
Sodium	405	100	20	75–125	80–120
Thallium	0.42	0.4	20	75–125	80–120
Vanadium	71.8	0.5	20	75–125	80–120

Table A-3-2: Project Quality Control Criteria for Soil Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Zinc	77.9	1	20	75–125	80–120
Dioxins and Furans (Extraction: SW3550B. Analysis: SW8290C) (pg/kg)					
2,3,7,8-TCDD	3,900	500[c]	25	40–135	40–135
1,2,3,7,8-PCDD	TEFsum[e]	2,500	25	40–135	40–135
1,2,3,4,7,8-HxCDD	TEFsum	2,500	25	40–135	40–135
1,2,3,6,7,8-HxCDD	TEFsum	2,500	25	40–135	40–135
1,2,3,7,8,9-HxCDD	TEFsum	2,500	25	40–135	40–135
1,2,3,4,6,7,8-HpCDD	TEFsum	2,500	25	40–135	40–135
OCDD	TEFsum	5,000	25	40–135	40–135
2,3,7,8-TCDF	TEFsum	500	25	40–135	40–135
1,2,3,7,8-PCDF	TEFsum	2,500	25	40–135	40–135
2,3,4,7,8-PCDF	TEFsum	2,500	25	40–135	40–135
1,2,3,4,7,8-HxCDF	TEFsum	2,500	25	40–135	40–135
1,2,3,6,7,8-HxCDF	TEFsum	2,500	25	40–135	40–135
1,2,3,7,8,9-HxCDF	TEFsum	2,500	25	40–135	40–135
2,3,4,6,7,8-HxCDF	TEFsum	2,500	25	40–135	40–135
1,2,3,4,6,7,8-HpCDF	TEFsum	2,500	25	40–135	40–135
1,2,3,4,7,8,9-HpCDF	TEFsum	2,500	25	40–135	40–135
OCDF	TEFsum	5,000	25	40–135	40–135
Miscellaneous analytes					
pH (units) (Method: SW9045C)	--	n.a.	n.a.	0.5 units	0.10 units

Notes:

mg/kg = milligrams per kilogram
μg/kg = micrograms per kilogram
pg/kg = picograms per kilogram
LCS = laboratory control sample
EPA = U.S. Environmental Protection Agency
-- = none established
MS = matrix spike
MSD = matrix spike duplicate
n.a. = not applicable
RPD = relative percentage of difference
%R = percent recovery
SW = Test Method Solid Waste (EPA 1997b)
TEFsum =calculated from TEF values as TEQ
TEF = toxicity equivalency factor
TEQ = toxicity equivalency quotient
WW = Water and Waste (EPA 1983)
(mdl) = Laboratory will report to the method detection limit.

[a] For VOCs, SVOCs, explosives, dioxins, and perchlorate, the lower of California Modified PRGs and EPA Region 9 PRGs residential (November 2000 Update) has been used; for metals, established background threshold levels (95th quantile) have been used (BNI 1996).

[b] Laboratory-specific performance criteria.

[c] Actual dioxin reporting limits are calculated based on sample-specific internal standard recovery data.

[d] Analysis by low-level selective ion monitoring.

[e] Project decision threshold is based on the analytes at 2,3,7,8 TCDD equivalent concentration.

Table A-3-3: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Total Volatile Petroleum Hydrocarbons (Extraction: SW 5030B. Analysis: SW8015B) (mg/L)					
Volatile Petroleum Hydrocarbons	1	1	25	70–130	75-125
Total Extractable Petroleum Hydrocarbons (Extraction: SW 3520C. Analysis: SW8015B) (mg/L)					
Extractable Petroleum Hydrocarbons	1	1	50	50-150	60-140
Volatile Organic Compounds (Extraction: SW5030B. Analysis: SW8260B) (µg/L)					
1,1,1,2-Tetrachloroethane	0.43[b]	0.5	30	65-135	65-135
1,1,1-Trichloroethane	200[c]	1	20	70–130	75-125
1,1,2,2-Tetrachloroethane	1[c]	1	20	70–130	75–125
1,1,2-Trichloroethane	5[c]	1	20	70–130	75–125
1,1,2-Trichlortrifluoroethane (F113)	1,200[c]	5	50	50-150	50-150
1,1-Dichloroethane	5[c]	1	20	70–130	75–125
1,1-Dichloroethene	6[c]	1	20	70–130	75–125
1,2- Dichlorotetrafluoroethane (F114)	--	5	50	50-150	50-150
1,2-Dichloroethane	0.5[c]	0.5	20	70–130	75–125
cis-1,2-Dichloroethene	61[b]	1	20	70–130	75–125
Trans-1,2-Dichloroethene	120	1	20	70–130	75–125
1,2-Dichloropropane	5	1	20	70–130	75–125
2-Butanone (MEK)	1,900[b]	100	40	50–150	60–140
2-Hexanone	--	50	40	50–150	60–140
4-Methyl-2-pentanone (MIBK)	160	50	40	50–150	60–140
Acetone	610	100	40	50–150	60–140
Benzene	1[c]	1	20	70–130	75–125
Bromodichloromethane	0.18[b]	0.17 (mdl)	20	70–130	75–125
Bromoform	8.5[b]	1	20	70–130	75–125
Bromomethane	8.7[b]	1	20	70–130	75–125
Carbon disulfide	1,000[b]	1	20	70–130	75–125
Carbon tetrachloride	0.6[c]	0.5	20	70–130	75–125
Chlorobenzene	70[c]	1	20	70–130	75–125
Chloroethane	4.6[b]	1	20	70–130	75–125
Chloroform	0.16[c]	0.26 (mdl)	20	70–130	75–125
Chloromethane	1.5[b]	1	20	70–130	75–125
cis-1,3-Dichloropropene	0.5[c]	0.5	20	70–130	75–125
Dibromochloromethane	0.13[c]	0.23 (mdl)	20	70–130	75–125
Dichlorodifluoromethane (F12)	1	1	40	50–150	60–140
di-Isopropyl Ether (DIPE)	--	5	40	50–150	60–140
Ethyl tert-butyl ether (ETBE)	--	5	40	50–150	60–140
Ethylbenzene	10	1	20	70–130	75–125

Table A-3-3: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Methy tertiary butyl ether (MTBE)	5	3	20	70–130	75–125
Methylene chloride	4.3	3	20	70–130	75–125
Styrene	1,600	1	20	70–130	75–125
Tertiary amyl methyl ether (TAME)	–	5	40	50–150	60–140
Tertiary butyl alcohol (TBA)	12	2	20	70–130	75–125
Tetrachloroethene	1.1	1	20	70–130	75–125
Toluene	720	1	20	70–130	75–125
trans-1,3-Dichloropropene	0.5	0.5	20	70–130	75–125
Trichlorfluoromethane (F11)	1,300[b]	5	40	50–150	60–140
Trichloroethene (TCE)	1.6	1	20	70–130	75–125
Vinyl Chloride	0.5	0.5	20	70–130	75–125
Xylenes (total)	1,400	1	20	70–130	75–125
Semivolatile Organic Compounds (Extraction: SW3520C. Analysis: SW8270C) (µg /L)					
1,2,4-Trichlorobenzene	190	10	30	44–142	44–142
1,2-Dichlorobenzene	370	10	30	42–155	42–155
1,3-Dichlorobenzene	5.5	10	30	36–125	36–125
1,4-Dichlorobenzene	5	5	30	30–125	30–125
2,2'-oxybis(1-Chloropropane)	0.96*	10	30	35–135	35–135
2,4,5-Trichlorophenol	3,600	10	30	25–175	25–175
2,4,6-Trichlorophenol	6.1	5	30	39–128	39–128
2,4-Dichlorophenol	110	10	30	46–125	46–125
2,4-Dimethylphenol	730	10	30	45–139	45–139
2,4-Dinitrophenol	73	10	30	30–151	30–151
2,4-Dinitrotoluene	73	10	30	39–139	39–139
2,6-Dinitrotoluene	36	10	30	51–125	51–125
2-Chloronaphthalene	490	10	30	60–125	60–125
2-Chlorophenol	30	10	30	41–125	41–125
2-Methylnaphthalene	–	10	30	41–125	41–125
2-Methylphenol	1,800	10	30	25–125	25–125
2-Nitroaniline	2.1*	50	30	50–125	50–125
2-Nitrophenol	--	10	30	44–125	44–125
3,3'-Dichlorobenzidine	0.15*	10	30	29–175	29–175
3-Nitroaniline	--	50	30	51–125	51–125
4,6-Dinitro-2-methylphenol	--	50	30	26–134	26–134
4-Bromophenyl-phenylether	--	10	30	53–127	53–127
4-Chloro-3-methylphenol	–	10	30	44–125	44–125
4-Chloroaniline	150	10	30	45–136	45–136

Table A-3-3: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
4-Chlorophenyl-phenyl ether	--	10	30	51–132	51–132
4-Methylphenol	180	10	30	33–125	33–125
4-Nitroaniline	--	50	30	40–143	40–143
4-Nitrophenol	290	50	30	25–131	25–131
Acenaphthene	360	10	30	49–125	49–125
Acenaphthylene	--	10	30	47–125	47–125
Anthracene	1,800	10	30	45–165	45–165
Benzo(a)anthracene	0.09*	10	30	51–133	51–133
Benzo(a)pyrene	*0.2*	0.2 [c]	30	41–125	41–125
Benzo(b)fluoranthene	0.09*	10	30	37–125	37–125
Benzo(g,h,i)perylene	--	10	30	34–149	34–149
Benzo(k)fluoranthene	0.92*	10	30	37–125	37–125
bis(2-Chloroethoxy)methane	--	10	30	49–125	49–125
bis(2-Ethylhexyl)phthalate	4.8*	10	30	33–129	33–129
bis-(2-Chloroethyl)ether	0.01*	10	30	44–125	44–125
Butylbenzylphthalate	7,300	10	30	26–125	26–125
Carbazole	3.4*	50	30	29–135	29–135
Chrysene	9.2	5	30	55–133	55–133
Di-n-butylphthalate	3,600	10	30	34–126	34–126
Di-n-octylphthalate	730	10	30	38–127	38–127
Dibenz(a,h)-anthracene	0.01*	10	30	50–125	50–125
Dibenzofuran	24	10	30	52–125	52–125
Diethylphthalate	29,000	10	30	37–125	37–125
Dimethylphthalate	360,000	10	30	25–175	25–175
Fluoranthene	1,500	10	30	47–125	47–125
Fluorene	240	10	30	48–139	48–139
Hexachlorobenzene	*1**	3.2 (mdl)	30	46–133	46–133
Hexachlorobutadiene	0.86*	10	30	25–125	25–125
Hexachlorocyclopentadiene	260	50	30	41–125	41–125
Hexachloroethane	4.8*	5	30	25–153	25–153
Indeno(1,2,3-cd)-pyrene	0.09*	10	30	27–160	27–160
Isophorone	71	10	30	26–175	26–175
N-Nitroso-di-n-propylamine	0.0036*	10	30	37–125	37–125
N-Nitroso-diphenylamine	140	10	30	27–125	27–125
Naphthalene	6.2	5	30	50–125	50–125
Nitrobenzene	3.4*	5	30	46–133	46–133
Pentachlorophenol	0.56*	12	30	28–136	28–136

Table A-3-3: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Phenanthrene	--	10	30	54–125	54–125
Phenol	22,000	10	30	25–125	25–125
Pyrene	180	10	30	47–136	47–136
Metals (Preparation: SW 3010B; Analysis: Mercury SW7471, all other metals SW6010) (µg/L)					
Aluminum	36,000	100	20	75–125	80–120
Antimony	15	10	20	75–125	80–120
Arsenic	0.045	2.0	20	75–125	80–120
Barium	2,600	10	20	75–125	80–120
Beryllium	73	2	20	75–125	80–120
Cadmium	18	2	20	75–125	80–120
Calcium	--	200	20	75–125	80–120
Chromium	64	5	20	75–125	80–120
Cobalt	2,200	5	20	75–125	80–120
Copper	1,400	10	20	75–125	80–120
Iron	11,000	50	20	75–125	80–120
Lead	0.0036*	5	20	75–125	80–120
Magnesium	--	100	20	75–125	80–120
Manganese	880	5	20	75–125	80–120
Mercury	11	0.5	20	75–125	80–120
Nickel	41,000	5	20	75–125	80–120
Potassium	--	400	20	75–125	80–120
Selenium	180	10	20	75–125	80–120
Silver	180	10	20	75–125	80–120
Sodium	--	2,000	20	75–125	80–120
Thallium	2.4	2.4	20	75–125	80–120
Vanadium	260	10	20	75–125	80–120
Zinc	11,000	10	20	75–125	80–120
Miscellaneous analytes					
Perchlorate (µg/L) (WW 314.1)	18	4	20	75–125	80–120
pH (units) (Method: SW9045C)	6.5-8.0	n.a.	n.a.	0.5 units	0.10 units

Notes:

mg/L = milligrams per liter
ng/L = nanograms per liter
µg/L = micrograms per liter
LCS = laboratory control sample
EPA = U.S. Environmental Protection Agency
-- = none established
MS = matrix spike
n.a. = not applicable
RPD = relative percentage of difference
% R = percent recovery
SW = Test Method Solid Waste (EPA 1997b)
WW = Water and Waste (EPA 1983)
MSD = matrix spike duplicate

* Laboratory reporting limits are greater than the project decision thresholds; see discussion in the subsection 'Reporting Limits' below for evaluation of these analytes.

Decision thresholds shown in italics are based on drinking water MCLs. PRGs for these compounds are too low to be detected with reasonable analytical confidence.

Table A-3-3: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS

[a] For VOCs, SVOCs, explosives, dioxins, perchlorate, and metals, the lower of California Modified PRGs and EPA Region 9 PRGs for residential tap water (November 2000 Update) have been used; for analytes whose PRGs are lower than the laboratory reporting limits, primary MCLs have been used.

[b] Laboratory-specific performance criteria.

[c] Analysis by low-level selective ion monitoring.

Table A-3-4: Project Quality Control Criteria for Soil Vapor and Ambient Air Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Volatile Organic Compounds (modified SW8260 or TO-14) (µg/L)					
1,1,1,2-Tetrachloroethane	1	1	20	n.a	75–125
1,1,1-Trichloroethane	1	1	40	n.a	60–140
1,1,2,2-Tetrachloroethane	1	1	20	n.a	75–125
1,1,2-Trichloroethane	1	1	20	n.a	75–125
1,1,2-trichlorofluoroethane (F113)	1	1	20	n.a	75–125
1,1-Dichloroethane	1	1	20	n.a	75–125
1,1-Dichloroethene	1	1	20	n.a	75–125
1,2-dichlorotetrafluoroethane (F114)	1	1	20	n.a	75–125
1,2-Dichloroethane	1	1	40	n.a	60–140
1,2-Dichloropropane	1	1	20	n.a	75–125
2-Butanone (MEK)	1	1	20	n.a	75–125
2-Hexanone	1	1	20	n.a	75–125
4-Methyl-2-Pentanone (MIBK)	1	1	20	n.a	75–125
Acetone	1	1	20	n.a	75–125
Benzene	1	1	20	n.a	75–125
Bromodichloromethane	1	1	20	n.a	75–125
Bromoform	1	1	20	n.a	75–125
Bromomethane	1	1	20	n.a	75–125
Carbon disulfide	1	1	20	n.a	75–125
Carbon tetrachloride	1	1	20	n.a	75–125
Chlorobenzene	1	1	20	n.a	75–125
Chloroethane	1	1	20	n.a	75–125
Chloroform	1	1	20	n.a	75–125
Chloromethane	1	1	20	n.a	75–125
cis-1,2-Dichloroethene	1	1	40	n.a	60–140
cis-1,3-Dichloropropene	1	1	20	n.a	75–125
Dibromochloromethane	1	1	20	n.a	75–125
Dichlorodifluoromethane (F12)	1	1	20	n.a	75-125

Table A-3-4: Project Quality Control Criteria for Soil Vapor and Ambient Air Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
di-Isopropyl ether	1	1	20	n.a	75-125
Ethyl tert-butyl ether	1	1	20	n.a	75-125
Ethylbenzene	1	1	20	n.a	75–125
Methyl tert- butyl ether	1	1	20	n.a	75–125
Methylene chloride	1	1	20	n.a	75–125
Styrene	1	1	20	n.a	75–125
Tertiary amyl ether	1	1	20	n.a	75–125
Tertiary butyl alcohol	1	1	20	n.a	75–125
Tetrachloroethene	1	1	20	n.a	75–125
Toluene	1	1	20	n.a	75–125
trans-1,2-Dichloroethene	1	1	40	n.a	60–140
trans-1,3-Dichloropropene	1	1	20	n.a	75–125
Trichlorofluoromethane (F11)	1	1	20	n.a	75–125
Trichloroethene	1	1	20	n.a	75–125
Vinyl chloride	1	1	20	n.a	75–125
m-xylene	1	1	20	n.a	75–125
o-xylene	1	1	20	n.a	75–125
p-xylene	1	1	20	n.a	75–125
1,2,4-Trichlorobenzene	1	1	20	n.a	75–125
1,2-Dichlorobenzene	1	1	20	n.a	75–125
1,3-Dichlorobenzene	1	1	20	n.a	75–125
1,4-Dichlorobenzene	1	1	20	n.a	75–125
Hexachlorobutadiene	1	1	20	n.a	75–125
Atmospheric Gases (ASTM-1946) (ppmv)					
Oxygen	1,000	1,000	20	n.a	75–125
Nitrogen	1,000	1,000	20	n.a	75–125
Carbon dioxide	10	10	20	n.a	75–125
Carbon monoxide	10	10	20	n.a	75–125
Methane	1	1	20	n.a	75–125

Notes:

μg/L = micrograms per liter
LCS = laboratory control sample
EPA = U.S. Environmental Protection Agency
MS = matrix spike
ppmv = parts per million, volume
n.a. = not applicable
RPD = relative percentage of difference
% R = percent recovery
MSD = matrix spike duplicate

[a] Project decision threshold is equal to the reporting limit. Decision threshold for the hot spot determination is 300 μg/L total VOC concentration.

[b] Laboratory-specific performance criteria.

[c]Target analytes for TO-14 only.

Reporting Limits. The laboratory will have current and documented reporting limits consistent with the values presented in Table A-3-2, Table A-3-3, and Table A-3-4. Reporting limits that exceed the selected decision criteria will be evaluated on an individual basis. Analytes not detected in any sample at the site or these are not the result of site activities will not be included in further evaluation. Analytes that are identified as site COPCs will be incorporated into the site evaluation and recommendations; the detection limit will be addressed as a factor in the uncertainty associated with the decision-making process.

Method Blanks. A method blank will be analyzed with every batch of 20 or fewer samples to measure laboratory contamination. The method blank will be an analyte-free matrix (water, soil vapor, or soil) that will be carried through the entire preparation and analysis procedure. If any analytes are found above reporting limits, the results of samples in the batch will be examined. Those analytes with results less than the reporting limit or greater than 10 times the value of the method blank will be accepted. Other samples will be reanalyzed in another batch. Consistent presence of contamination will require investigation and correction.

Laboratory Control Samples. A laboratory control sample (LCS) will be analyzed with every batch of 20 samples or less for accuracy. The LCS will consist of a method blank spiked with a known amount of analyte that will be carried through the entire preparation and analysis procedure. The LCS source will be different from that used to prepare calibration standards. Analytes used for the LCS will comply with the method requirements. Control charts may be used, and control limits will be calculated based upon historical data. When control limits are exceeded, the analysis will be stopped, and the problem corrected. Samples associated with the out-of-control LCS will be reanalyzed in another batch, unless documented evidence is presented to show that associated samples were not affected. Guidance limits for the LCS listed in Table A-3-2, Table A-3-3, and Table A-3-4 will be used unless more restrictive laboratory-specific limits are established or statistically based limits are developed.

Matrix Spikes. A matrix spike (MS) will be analyzed for at least one out of every 20 samples to measure matrix effects on accuracy. The MS will consist of additional aliquots of sample spiked with a known amount of analyte. Compounds to be spiked will be in accordance with the laboratory SOP or the published method. Guidance limits for the MS listed in Table A-3-2, Table A-3-3, and Table A-3-4 will be used unless more restrictive laboratory-specific limits are established. If the analyte concentration in the sample is greater than twice the amount of spike added, the spike will be considered invalid and the recovery will not be calculated. If a valid spike recovery exceeds acceptance limits but the LCS is in control, matrix interference is indicated.

Duplicates or Matrix Spike Duplicates. A duplicate or a matrix spike duplicate (MSD) will be analyzed for at least one out of every 20 samples to measure precision. For any batch of samples that does not contain a duplicate or MSD (i.e., when insufficient sample is available), two LCSs may be used. However, every effort will be made to provide sufficient sample for laboratory QC. If the relative percentage of difference (RPD) does not meet the established acceptance limits, the problem will be investigated and corrected. Any affected samples will be reanalyzed in a separate batch. Acceptance limits for duplicates and MSDs listed in Table A-3-2, Table A-3-3, and Table A-3-3 will be used unless more restrictive laboratory-specific limits are established or statistically derived limits are developed.

Surrogates. Surrogate spikes will be added to all samples for organic analyses to measure sample-specific accuracy. Surrogate spike acceptance criteria are developed by the laboratory and will be provided with the data package.

A-3.2.4 Calibration and Preventive Maintenance

The laboratory is required to document calibration procedures in accordance with Appendix C, section 5.9.4 of the Navy *IRCDQM* (NFESC 1999). Calibration procedures will be consistent with specified method requirements.

The laboratory will perform preventive maintenance on instruments used to analyze project samples and will keep records of all such maintenance in accordance with section 5.8 of Appendix C of the *IRCDQM*. Preventive maintenance documentation is incorporated into laboratory certification requirements and is an element of the subcontractor laboratory quality assurance plan, which will be reviewed and approved prior to selection of a CLEAN II subcontractor laboratory.

A-3.2.5 Acceptance Requirements for Supplies and Consumables

Supplies and consumables that have the potential to effect data quality will include sample containers and preservatives. All sample containers and preservatives will be provided by the laboratory. The laboratory will track sample container and preservative sources and ensure that the containers are free from contamination. Field blanks will serve as an independent verification of consumable integrity.

Consumables used in sample collection include the tubing installed in each well. New materials in original packaging from the supplier will be used and selected on the basis of being appropriate for the application.

A-3.2.6 Data Management

The laboratory will verify, reduce, and report data as specified in their laboratory QA plan and in accordance with the laboratory SOW. Both hard copy and electronic data deliverables (EDDs) will be required within 30 days of sample receipt. The format for both hard copies and EDDs is specified in the subcontract. Hard copy data will be delivered on CLP-like forms, along with a case narrative, table of contents, and raw data for Level IV QC deliverables.

Printed laboratory reports will be received and reviewed for completeness and compliance with the laboratory SOW. The project chemist will immediately review the case narrative and report to project management any issues that may effect the project conclusions or schedule. The project chemist will also ensure that appropriate copies are provided to technical staff, data validation personnel, and the CTO manager.

Electronic data deliverables will be received on diskettes or through electronic mail in the format specified in the analytical laboratory technical specifications. Electronic data deliverables will be loaded into a database management system and checked for completeness and errors. Part of this check involves verifying that all requested analyses for each sample are performed and reported. This may be accomplished by comparing the delivered results to those recorded electronically. If errors are encountered or data are not complete, the laboratory will be notified and data will be resubmitted. If only minor errors or omissions are encountered, data management personnel will manually correct the data, but the laboratory will be notified so that it can rectify the problems for future projects. Once in the database, the records will be made accessible to project personnel.

The electronic data versus hard copy data will be manually verified for the entire project. Final data tables will be compared to the database to verify the output.

Computer files will be backed up daily to avoid loss of information. Hard copy data will be stored in secure areas, while electronic data will be stored in password-protected files, with read-only access to users who do not have authorization to edit the data. The data will be stored for 10 years after the close of the PACNAVFACENGCOM CLEAN II contract.

A-3.3 PROJECT QUALITY ASSURANCE OVERSIGHT

Samples will be submitted to an NFESC-evaluated and approved laboratory for analysis by methods cited in Table A-3-2, Table A-3-3, and Table A-3-4. The laboratory will also be certified by the California State Environmental Laboratory Accreditation Program (ELAP). Laboratory data quality strategies and criteria were developed in accordance with the project DQOs and the following references:

- *Installation Restoration Chemical Data Quality Manual* (NFESC 1999)
- *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods (SW846)* (EPA 1997b)
- *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analysis* (EPA 1999a)
- *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analysis* (EPA 1999b)

System and performance audits are a fundamental element of the QA process and are the tool used to demonstrate compliance with data quality requirements.

Overall responsibility for implementation and monitoring of the Earth Tech QA program resides with the CLEAN II project quality manager. The CLEAN II project quality manager and the CTO manager will be responsible for reviewing the technical contents of all submittals required under this project. The QA activities applicable to this CTO are described in Standard Operating Procedures (BNI 1999). The Earth Tech peer review program will be followed during this project.

A-3.3.1 Field Audits

The project chemist is anticipated to visit the site weekly during fieldwork to assess field practices for compliance with procedures and requirements. Documentation of the review shall be included in the project files.

A-3.3.2 Laboratory System Audits

Laboratories solicited for this project are required to have successfully completed evaluation by the NFESC. Further evaluation of laboratory performance will be through data package reviews and oversight by the project chemist.

A-3.3.3 Laboratory Performance Review

Continual laboratory performance reviews will be conducted for the project. This will consist of the following tasks:

- Internal laboratory oversight by laboratory QA manager;
- Frequent progress reports and discussions between the project chemist and the laboratory project manager;
- Project chemist oversight of deliverables and reports;
- Desktop evaluation of reports and data packages;
- Data validation, as discussed in section A-3.4.2.

A-3.3.4 Performance Evaluation Samples

Laboratory performance will be assessed using commercially available performance evaluation (PE) samples. Samples will be submitted as blind or double-blind samples within the first week of fieldwork. Results of the analysis will be compared to the statistically derived acceptance criteria provided by the PE sample vendor. The results of the assessment will be included in the discussion of data quality in the report.

A-3.3.5 Corrective Actions

Corrective action requests will be issued and tracked by the project chemist when deficiencies or instances of noncompliance are noted, whether in field audits or laboratory evaluations. These findings will be resolved in a timely manner, typically within 30 days, by the project manager and documented in the project file. Findings that affect the collection or interpretation of project data will be noted in the laboratory case narrative and, as necessary, the pilot test report.

A-3.3.6 Reports to Management

Documentation of audits, copies of audit checklists, and copies of corrective action reports will be included in project files to be reviewed during management evaluation of project progress. Significant corrective actions, which are identified as having a direct effect on data quality or project completion, will be addressed by the CTO manager in writing to the program manager.

A-3.4 DATA VALIDATION AND USABILITY

All data developed in the course of the project will be evaluated for usability and compliance with measurement quality objectives. Field data will be tabulated and presented in the context of the data gathering activity. Laboratory data will be validated as specified below in accordance with the project data quality objectives (DQOs) and SWDIV's environmental work instructions.

A-3.4.1 Desktop Data Review

Upon receipt, all field data will be reviewed by the field manager and project manager for internal consistency and completeness. Laboratory data will be reviewed by the project chemist and the project geologist for applicability to the assessment of the site.

A-3.4.2 Data Validation

The data validation strategies presented in the SWDIV EWI #1 specify investigations at National Priorities List (NPL) sites will be subject to a minimum of 20 percent Level IV validation, with the remainder of the data subject to Level III validation.

Due to the nature of the validation process, Level III and IV data validation will be performed on complete sample delivery groups, i.e., all samples in a package will be validated at Level III or IV as assigned. This may result in a higher percentage of Level IV validated data than planned, but the approach will save in management and tracking resources.

A-3.4.2.1 LEVEL III VALIDATION

A minimum of Level III validation, as described in SWDIV EWI #1, will be performed on all samples collected during the investigation. Systematic concerns identified in Level III may be cause for additional Level IV review. Such review will be conducted until a return to compliance is verified.

A-3.4.2.2 LEVEL IV VALIDATION

Level IV validation will be performed on at least 20 percent of the samples, typically the first data packages submitted by the laboratory. The Level IV validation is intended to identify if any significant, systematic errors are present in the laboratory procedures or processes. If the Level IV validation identifies systematic errors, the laboratory will be required to initiate corrective action and ensure that such errors are corrected.

A-3.4.3 Data Usability

The final report will summarize the data validation findings, indicating the processes and findings of the review process. Data reported in the project report will be flagged with appropriate qualifiers to indicate the usability.

Data may be assigned the following qualifiers:

- J – estimated concentration
- N – presumptive evidence of the identification of an analyte
- R – rejected data (unusable)
- U – not detected (e.g., not present because of blank contamination)

Combinations of qualifiers such as UJ and NJ are possible. Where the validation qualifiers affect the project decision recommendations, the report will evaluate the issue and implement the necessary corrective action.

A-4. REFERENCES

Bechtel National, Inc. 1999. *CLEAN II Program Procedures Manual*. San Diego, CA.

California Regional Water Quality Control Board (CRWQCB). 1997. *Interim Guidance for Active Soil Gas Surveys*.

Earth Tech, Inc. 1998. *CLEAN Field Health and Safety Manual.* Honolulu.

Environmental Protection Agency (EPA). 1994a. *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analysis*. Washington, D.C.

———. 1994b. *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analysis.* Washington, D.C.

———. 1997b. *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods (SW846).* Washington, D.C.

———. 1999a. *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analysis*. Washington, D.C. October

———. 1999b. *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analysis.* Washington, D.C. October

———. 2000. *Guidance for the Data Quality Objectives Process*. EPAQA/G-4. Washington, D.C. September.

Naval Facilities Engineering Service Command (NFESC). 1999. *Installation Restoration Chemical Data Quality Manual.* Port Hueneme, CA. October.

Southwest Division, U.S. Naval Facilities Engineering Command (SWDIV). 2001. *Environmental Work Instructions (EWI)*. San Diego, California. November.

World Health Organization (WHO). 1997. *Toxicity Equivalent Factors* (TEF). Geneva.

Attachment 1
Standard Operating Procedure
Soil Gas Investigations at Former MCAS El Toro

1. PURPOSE

This standard operating procedure (SOP) describes soil gas surveying procedures for use by Earth Tech personnel for projects at MCAS El Toro under the direction of the Naval Facilities Engineering Command, Southwest Division. The work will be conducted by subcontractors under the direction of Earth Tech personnel in accordance with this procedure.

2. SCOPE

This procedure has been developed to serve as Contract Task Order (CTO) Management approved guidance for activities at MCAS El Toro. It is not intended to obviate the need for professional judgment that may arise in unforeseen circumstances. Deviations from this procedure in planning, or executing planned activities, must be approved by the CTO Manager through the use of a Field Change document or revision to the Work Plan/Sampling and Analysis Plan.

3. RESPONSIBILITIES

The CTO Manager or designee is responsible for ensuring that the soil gas survey activities conducted during the investigations at El Toro are in compliance with this procedure. The CTO Manager is also responsible for ensuring that the soil gas survey is conducted under the supervision of an Earth Tech representative. It is recommended that supervisory personnel have a thorough understanding of the principles of soil gas and the physical characteristics of the vadose zone. This should be determined in consultation with the Technical Director/QA Program Manager. To a certain extent, adequate understanding of the physical characteristics of the vadose zone by field supervisory personnel is site specific and is subject to the judgment of the Technical Director/QA Manager.

The Field Manager is responsible for ensuring that all project field staff and subcontractor staff members are familiar with these procedures. The sampling and analysis methods employed by the subcontractor must be in compliance with the methods listed in this procedure. The methods and equipment proposed for use by the subcontractor will be evaluated prior to awarding the job.

The Technical Director/QA Program Manager is responsible for conducting evaluations to ensure that these procedures are being utilized appropriately.

4. BACKGROUND INFORMATION

The soil gas survey is a semi-quantitative technique for evaluating the distribution of contaminants in soil gas. The resulting data can be used to qualitatively evaluate the potential for, and extent of, certain types of contamination in soil and ground water.

The use of soil gas surveying to locate potential source areas of subsurface contamination is based on aqueous phase/vapor phase equilibrium in the subsurface. Because of their relatively low solubilities and high vapor pressures, volatile organic compounds (VOCs) have a tendency to partition from the aqueous phase into the soil vapor phase. Certain semivolatile compounds also behave in this manner. Generally speaking, an organic compound with a relatively high Henry's law constant (i.e., the ratio of a compound's vapor pressure to its solubility in water) is likely to partition from soil or ground water into soil gas. The presence of VOCs in shallow soil gas depends on the following factors: (1) the volatilization of VOCs from soil or ground water into the soil gas, (2) the presence of a chemical gradient in soil gas between the contaminant source and the ground surface, and (3) the physical properties of the soil. If VOCs are present in the soil gas in large enough quantities, they can be detected during a soil gas survey.

Fixed gas (i.e., O_2 and N_2) and biogenic gas (i.e., CO_2, CH_4, N_2O, and H_2S) data obtained during a soil gas survey also provides an indication of potential subsurface contamination. A concurrent increase in carbon dioxide and decrease in oxygen often indicates increased chemical or biological breakdown of organic compounds. This phenomenon is usually associated with the degradation of petroleum hydrocarbons; however, moisture content, natural organic content, and reduction/oxidation (redox) conditions in the soil can also affect fixed gas/biogenic gas ratios.

5. EQUIPMENT

The following equipment is typically required to conduct the soil gas survey:

- Hydraulic driving/hammering system designed to install or remove sampling probes
- Stainless steel drive points
- Tubing, pumps, and vials, for collecting and preparing soil gas and/or groundwater samples
- Oil less air pump and evacuation chamber for collecting the samples.
- Bubble flowmeter and stop watch.

Analytical instrumentation and chemical supplies may include the following:

- Gas chromatographs (GCs)
- Electron Capture Detector (ECD), Flame Ionization Detector (FID), Mass Spectrometer (MS)
- Computer-based data management systems
- UHP grade compressed analytical gases (nitrogen, helium, hydrogen, air)
- Certified standards for target analytes.
- High resolution megabore, packed, and capillary gas chromatographic columns
- Fittings, tools, plumbing, and glass syringes required for normal GC operation

6. SAMPLING DESIGN

The design depends on the objectives of the program and the types of contaminants anticipated to be present. The following items shall be considered when designing a soil gas program.

- **Number of Samples**. This depends upon the extent of anticipated contamination, the size of the site, and the selected sample spacing.

- **Anticipated Soil Types**. The lithology must be considered when determining sampling locations, distance between samples, and sampling depth.
- **Depth of Samples**. This will depend on the type of contamination, the depth to ground water, and the objectives of the survey.
- **Distance Between Samples**. For detecting the limits of plumes, spacing may be 50 to 100 feet or greater. Around a buried tank, spacing may be a few feet. The relative air permeability of the soil type(s) present must also be considered. Soils with low air permeabilities (i.e., clays) may require closer sample spacing. Spacing should be selected based on the objective(s) of the survey, subsurface conditions, and the nature of the target compounds. These factors shall be addressed in the Work Plan and Field Sampling Plan.
- **Sampling Point Selection**. Large spills, leaks, or plumes are often sampled on a predetermined sampling grid. Initial surveys may be random or based on real-time field data. Location access may also be an important factor.
- **Objectives of the Survey**. If plume definition is the objective, probe locations should be established to define the down-gradient and lateral extent of the VOCs in soil vapor. If source delineation is the objective, probes should be located in proximity to suspected source areas. In either case, some sampling points should be included within the known plume area and well outside contaminated areas in order to provide a basis for correlation and comparison to background levels of VOCs.
- **Timing of Sampling**. Probe locations can be sampled in stages to meet the objectives of the survey. The first stage of sampling may involve widespread spacing of the probes. Later sampling should focus on areas where VOCs were detected during the first stage of sampling to define the lateral extent of soil gas contaminants, or delineate a source area. Later sampling events should include some overlap with earlier sampling points in order to provide a basis for correlation between data sets.
- **Selection of Analytes**. In general, only contaminants with relatively high Henry's law constants are amenable to detection using soil gas. However, biodegradative breakdown products (CO_2, O_2, and CH_4) of less volatile contaminants can be used to evaluate certain semivolatile and non-volatile compounds. Analysis should focus on known indicator compounds at the site. The more analytes selected, the fewer locations that can be sampled in a day. Analytes should be selected to sample the compounds necessary to meet the objectives of the study and to maximize the number of locations sampled in a given period of time.

7. SAMPLE COLLECTION

The following describes procedures for soil gas surveys utilizing direct-push probe advancement. Procedures may be modified based on specific project needs.

7.1 Sample Point Installation

A probe tip is attached to sample tubing for collection of soil vapor samples at discrete intervals. The drive rod and probe tip is advanced to the desired depth. The drive rod is retracted slightly while the probe tip remains in place, allowing for sampling of soil vapors in an opening between the drive rod and probe tip. The probe tip must be the same diameter as the drive rod so as not to create a channel for infiltration of surface air into the sample point.

7.2 Sample Pumping Rate Determination

Prior to sample collection, the flow rate of the sample evacuation pump is determined with the bubble flow meter.

7.3 Sample Collection.

The volume of the sample tubing is determined and 3–5 volumes purged from the sample line before collecting the sample for analysis. After purging, soil gas samples are withdrawn from the moving sample stream using a glass syringe fitted with a disposable needle and Mininert (or equivalent) gas-tight valve. Care must be taken to minimize the volume of purged soil gas.

Following collection of a soil gas sample, the drive rod is advanced. This process re-seats the probe tip in the drive shoe. The drive rod is advanced to the next discrete sampling interval and the process is repeated. New sample tubing is used at each sampling interval. Following removal of the drive rod, the steel probe point remains down-hole and the remaining annulus is filled with hydrated bentonite/cement slurry to slightly below grade. The remaining depression is filled with concrete patch material and finished flush with grade.

Soil gas samples should not contact potentially sorbing materials such as the pump diaphragm or soft tubing. All components of the sampling system should be checked for contamination by drawing atmospheric air through the system, subjecting it to analysis, and comparing the resulting chromatogram with that of ambient air. Precleaned probes shall be used for each sample location in order to minimize the possibility of cross-contamination among sampling locations. Sampling components, such as the probes, shall be cleaned using steam or pressurized water and detergent at the conclusion of each day and shall be cleaned immediately after use with a portable sprayer as described in SOP I-F, *Equipment Decontamination*. Sections of drive rods may be reused only if analyses indicate that no target analytes are present. Sampling syringes must be decontaminated prior to use.[1]

Duplicate soil vapor samples for off-site analysis are collected by connecting dedicated sections of polyethylene tubing to a low-volume vacuum pump and filling a Tedlar bag or evacuated cylinder. The pump is purged between sample locations and is checked for residual VOC contamination either by onsite GC analysis or by collecting field "blanks" which are submitted to a laboratory. Gas containers are normally transferred under chain-

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[1] This SOP assumes that syringe sampling will be conducted. Other sampling techniques shall be documented in the project-specific Work Plan or FSP

of-custody procedures to a commercial laboratory where they are analyzed according to the specified methods. The percentage of duplicates submitted for laboratory analysis depends on project-specific objectives and regulatory specifications that shall be defined in the Work Plan or FSP.

8. SAMPLE ANALYSIS

Soil gas samples will be analyzed in the field using by GC or GCMS. The subcontractor must have on site operating procedures for the equipment used.

8.1 TARGET LIST ANALYSIS

A typical list of the target compounds is shown in Table 1. Actual analytes are specified in the project plans. Specific procedures for operation of the analytical systems are not provided here.

Table 1: Halogenated and Aromatic Hydrocarbons – 25 Target Compound List
Dichlorodifluoromethane
Vinyl Chloride
Chloroethane
Trichlorofluoromethane
1,1,2-Trichloro-trifluoroethane
1,1-Dichloroethene
Methylene Chloride
Trans-1,2-Dichloroethene
1,1-Dichloroethane
Cis-1,2-Dichloroethene
Chloroform
1,1,1-Trichloroethane
Carbon tetrachloride
Benzene
1,2-Dichloroethane
Fluorobenzene (surrogate)
Trichloroethene
Cis-1,2-Dichloropropene (surrogate)
Toluene
1,1,2-Trichloroethane
Tetrachloroethene
1,1,1,2-Tetrachloroethane
Ethylbenzene
Meta and para-Xylene
Ortho-Xylene
1,1,2,2-Tetrachloroethane

The instrument used for soil gas analyses will be calibrated using high-purity solvent-based standards obtained from vendors providing certificates of traceability. Calibration using solvent-based standards will typically be performed using varying injection volumes of the stock solvent-based standard without dilution. If necessary, stock solvent-based standards will be diluted to an appropriate concentration. Diluted standards will be prepared by introducing a known volume of stock solvent-based standard into a known volume of high-purity solvent.

Initial calibration will be performed for all target compounds. The instrument will be calibrated using a minimum of three standards spanning the working range of the analysis. The lowest standard will not be higher than five times the method detection limit (or 5 µg/L). The percent relative standard deviation (%RSD) of the response factor (RF) for each target compound will not exceed 20 percent except for Trichlorofluoromethane (Freon-11), Dichlorodifluoromethane (Freon-12), Trichlorotrifluoroethane (Freon-113), Chloroethane (CE), and Vinyl Chloride (VC) which will not exceed 30% RSD[2]. Identification and quantitation of compounds in the field will be based on calibration under the same analytical conditions as for three-point calibration.

8.1.1 Detection Limits

Detection limits for the target compounds will be no more than one microgram per liter (µg/L) of gas except when the compound concentration exceeds the initial calibration range requiring sample dilution (smaller sample injection volume), thus resulting in raised detection limits for the analysis. Method detection limits will be verified by annual performance of an MDL study, in accordance with the procedures in 40 CFR Part 136.

8.1.2 Compound confirmation

All compounds detected will be confirmed by either second column or second detector or by GC/MS analysis.

8.1.3 Surrogate compounds

Two (2) surrogate compounds will be added to all analyzed samples. Surrogate compound concentrations will be within the calibration range. The percent recovery of the surrogate compounds will be calculated and reported with soil gas sample results. The acceptance goal for surrogate recovery is ±25 percent difference from the true concentration of the surrogate compounds. Surrogate compounds added to each sample analyses run will include fluorobenzene (PID) and cis-1,3-dichloropropene (PID and ELCD), each at a true concentration of 5,000 µg/L.

8.1.4 Laboratory control sample

A laboratory control sample (LCS) from a source other than initial calibration standard will be used to verify the true concentration of the initial calibration standard. The LCS will include the target compounds and the RF for each compound will be within ±15 percent different from the initial calibration.

8.1.5 Daily mid-point calibration check

Daily field calibration of the GC will consist of mid-point calibration analyses using the same standard as used for the initial multi-point calibration. The daily mid-point calibration check will include the 12 target compounds as specified in the previously referenced requirements. The RF of each compound (except for Freon-11, -12, and –113, CE and VC) will be within 15 percent difference of the average RF from the initial calibration. The RF for the Freon-11, -12, and –113, CE and VC will be within 25 percent

[2] Standards specified in RWQCB 1997.

difference of the initial calibration. If these criteria are not met, the GC will be re-calibrated.

Daily calibration will be performed prior to the first sample analysis of the say. One-point calibration will be performed for all compounds detected at a particular site to ensure accurate quantitiation. Subsequent calibration episodes, if deemed necessary, will consists of at least one injection of the standard exhibiting a similar detector response as that of samples encountered in the field.

8.1.6 End of day GC test run

A LCS will be analyzed at the end of each day. The LCS will contain the same compounds as the daily mid-point calibration standard (minimum 12 compounds). The LCS must be from a second source independent from the initial multi-point calibration standard. The RF for each compound will be within 20 percent difference of the average RF for the initial calibration. If these criteria are not met, additional LCS will be analyzed to satisfy these criteria.

8.2 METHANE BY GC/FID

Soil gas samples for methane will be analyzed in the field using a field-operable gas chromatograph equipped with a flame-ionization detector (FID) following a modified 8015 procedure. Detection limits for the Methane analysis will be one part per million by volume (ppmv).

8.2.1 Initial multi-point equipment calibration

Methane soil gas analyses will be calibrated using a compressed gas standard obtained from a certified vendor. Initial calibration will be performed using three standard injections of varying volume to establish a three-point calibration curve. This will typically include 200 μL, 400μL, and 600 μL injections of the gas-phase Methane standard. The three-point calibration will be used to establish an average response factor (ARF) for use in quantitated Methane concentrations in field samples. Identification and quantitation of Methane in the field will be based on calibration under the same analytical conditions as for three-point calibration.

8.2.2 Laboratory control sample

A laboratory control sample (LCS) from a second source is not required for the methane analysis.

8.2.3 Daily mid-point calibration check

Daily calibration of the gas chromatograph will consist of a mid-point calibration analysis using the compressed gas methane standard used for the initial multi-point calibration. The RF will be within 20 percent difference of the average RF from the initial calibration. If these criteria are not met, the GC will be re-calibrated. Daily calibration will be performed prior to the first sample analyses of the day. Subsequent calibration episodes, if deemed necessary, will consist of at least one injection of the standard exhibiting a similar detector response as that of sample encountered in the field.

8.2.4 End of day GC test run

A LCS will be analyzed at the end of each day. The RF will be within 20 percent dfference of the average RF for the initial calibration. If these criteria are not met, additional LCSs will be analyzed to satisfy these criteria.

8.3 DECONTAMINATION PROCEDURES

Probes and equipment in contact with the soil gas sample stream will be decontaminated prior to initiation of sampling. Decontamination of soil gas sampling equipment will be conducted by repeated washing and/or by baking in the gas chromatograph oven. Washing will include the use of a phosphate-free detergent wash, tap water rinse, organic-free water rinse, and followed by air-drying.

9. DOCUMENTATION/RECORDS

Each soil gas sampling event shall be documented by the subcontractor in a bound logbook or appropriate field log sheets. The following information shall be recorded for each soil gas sampling event:

- Sample number
- Project name and number
- Sample location and depth
- Date and time
- Name(s) of sampling personnel
- Site location
- Miscellaneous observations
- Analytical equipment utilized (e.g., GC, column, detector, etc.)

Other documentation will be recorded on a daily basis in the bound field notebook, and will include:

- Calibration results and
- Blank measurement results.

The original field records will be placed in the project files immediately upon completion of fieldwork. Subcontractors shall prepare a detailed report summarizing the methodologies used during the survey, the results obtained, and an interpretation of the results. This report will be incorporated into the site characterization report or equivalent document.

10. QUALITY CONTROL

Measurements collected to ensure the data meets the requirements of the project will include field and laboratory quality control analysis. The following are required under this SOP. Samples will be collected in accordance with Table 2.

Table 2: Field Quality Control Analysis Requirements for Soil Gas Surveys

Description	Frequency	Precision Goal %Rec
Background Sample (1)	One per day	N/A
Syringe Blank	As needed(1)	N/A
Field duplicate	1 per 10 field samples	15%

%Rec = Percent Recovery.
N/A = Not Applicable
(1) A syringe/background sample will be analyzed using ambient air. If volatile organic compounds (VOCs) are not detected, the ambient air sample will represent the background sample and syringe blank. If VOCs are detected in the ambient air sample, a syringe blank will be analyzed using ultra-high-purity helium or nitrogen gas.

10.1 FIELD SAMPLING QUALITY CONTROL MEASUREMENTS

10.1.1 Field Duplicates

Field duplicates shall be collected and analyzed at a frequency of 1 per 10 samples. The field duplicate shall be within 15% RSD of the original analysis

10.1.2 Field Blank

The syringes used for soil gas sample collection will be filled with ambient air or high-purity carrier-grade gas from a compressed gas cylinder. The ambient air or high-purity gas will be injected directly into the GC. The blank injection will serve to detect contamination of the syringe to be used for sampling and verify the effectiveness of equipment decontamination procedures.

10.2 LABORATORY QUALITY CONTROL MEASUREMENTS

Table 3: Summary of Quality Assurance/Quality Control Analytical Requirements for Soil Gas Surveys

Calibration and Laboratory Control Samples		
Description	**Frequency**	**Precision Goal %RSD or %DIFF**
Initial Multi-point Calibration (25 Target Compounds)	At the beginning of the soil gas survey, unless the RPDs of the initial laboratory check sample or daily mid-point calibration check samples exceed their goals.	20-30
Initial Laboratory Control Sample (25 Target Compounds)	At the beginning of the survey, following the initial three-point calibration.	15
Daily Mid-point Calibration Check (12 Target Compounds)	At the beginning of each day.	15 25
Last GC Test Run	At the end of the day if all samples from that day of analysis show non-detect (ND) results.	At least 50% of recovery.

10.2.1 Laboratory Duplicate

Laboratory duplicates shall be analyzed at a frequency of 1 per 10 samples. The duplicate shall be within 15% RSD of the original analysis. Failure of results to achieve the criteria shall require corrective action before continuing analysis.

10.2.2 Laboratory Blank

A blank of ambient air or purified air will be run at a minimum of 1 per 10 samples if all samples have detectable concentrations of any target analytes, demonstrating that the analytical system is in control.

11. HEALTH AND SAFETY

Soil gas surveyors are considered task specific workers and, therefore, must meet all requirements of said workers for health and safety reasons. In addition, adherence to safe work practices as outlined in the site-specific Health and Safety Plan (HSP) is required. Analyses should be conducted in a location that will not contaminate analytical equipment nor expose the public or analyst to unacceptable levels of contaminants. "Detector" and "vent" outlets should be vented through a combustion furnace (>1,500°F), an activated charcoal filter, or to an external atmosphere not endangering the general public. If anticipated conditions warrant a real/time immediate response instrument such as an OVA, PID, HNU, Thermo, or Draeger or Sensidyne tubes, it should be used to monitor the atmosphere.

When real/time instrument response exceeds the Permissible Exposure Limit (PEL), or the more conservative threshold limit value (TLV), appropriate previously defined PPE will be donned and alternate arrangements to ensure analytical personnel safety shall be considered. If safe alternatives are not achievable, the soil gas survey will be discontinued immediately.

When there is a danger of leakage from sample or gas standards containing hazardous materials and reagents, they should be stored outside of the workplace occupied by the analyst in a manner consistent with storage of hazardous or compressed gases and in a configuration such that the public will not be endangered by exposure.

In addition to the aforementioned precautions, the following safe work practices will be employed:

Chemical Hazards Associated With Soil Gas Survey

- Avoid skin contact with and/or incidental ingestion of solvents.
- Utilize PPE as deemed necessary while collecting samples and performing analyses.
- Refer to Manufacturer Safety Data Sheets (MSDSs), safety personnel, and/or consult sampling personnel regarding appropriate safety measures.
- Take necessary precautions when handling reagents and samples.

Physical Hazards Associated With Soil Gas Survey:

- To avoid possible back strain associated with sample collection, use the large muscles of the legs, not the back, when retrieving soil gas probes.
- To avoid heat/cold stress as a result of exposure to extreme temperature and PPE, drink electrolyte replacement fluids (1-2 cups/hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.

- Be aware of restricted mobility due to the wearing of PPE.

12. REFERENCES

U.S. EPA Environmental Response Team. 1988. Response Engineering and Analytical Contract Standard Operating Procedures. U.S. EPA, Research Triangle Park, NC.

U.S. EPA. 1991. Soil Vapor Extraction Technology: Reference Handbook. February.

13. ATTACHMENTS

None.

Appendix B
Responses to Comments

Document Title: Page 1

(1) Geologic/Hydrologic Responses to the Responses to Comments, Draft Work Plan, Removal Site Evaluation, Anomaly Area 3, Marine Corps Air Station, El Toro, California

Reviewer: Dave Murchison, R.G., Hazardous Substances Engineering Geologist, Cypress Geological Services Unit, April 29, 2002

Comment No.	Section/ Page No.	Comment	Response
GENERAL COMMENTS			
1.		There appears to be a gap with respect to stratigraphy of native soil and bedrock underlying the Site. These underlying material will be vital in containing or controlling the migration of leachate, and may, where saturated, supply water to the waste, creating additional leachate even if an effective surface cap is in place. This material appears to be of variable lithology, including Poorly Graded (SP) sands and various materials that may exhibit fairly high permeability. No discussion of the structure of these rocks is presented. No discussion of the presence, geometry, or abundance of fractures is supplied. The contractor should propose additional investigation to map the geometry, extent, thickness, and probable lithology of the bedrock units, and evaluate the density and orientation of fractures in the subsurface of the area. Once these units are mapped and characterized in three dimensions, the contractor should propose an investigation designed to test the most likely routes of leachate migration in the subsurface. If significant DNAPL species are defined during soil vapor and soil matrix sampling, the contractor should include an analysis of the most likely zones of deep DNAPL pooling. 1.1 Contractor's Reply: The boring logs of the existing wells were reviewed to evaluate the stratigraphy of native soil and bedrock underlying the site; a figure illustrating this is attached and will be included in the Work Plan. Evaluation and presentation of the bedrock-alluvium contact will be accomplished via preparation of stratigraphic cross sections and presented in the RSE Technical Memorandum, along with a discussion of the fractures and bedrock units, as appropriate. Characterization of groundwater flow paths, likely routes of leachate migration, and chemical impact to groundwater (if any) will be accomplished during evaluation of groundwater elevation data and groundwater analytical results after the proposed wells have been installed, gauged, and sampled.	A teleconference took place on May 23, 2002 in which representatives from Southwest Division, DTSC, and Earth Tech participated. Following this the BCT briefing took place on May 29, 2002 in which representatives from Southwest Division, U.S. EPA, DTSC, and the California Regional Water Quality Control Board (Water Board participated. DTSC also sent an e-mail correspondence on June 2, 2002 with modifications to this correspondence. Additional boreholes will be drilled as shown on Figure 4-3. However, it should be noted that based on the discussion during the BCT briefing, boreholes will not be advanced through the waste placement (beneath the site). A network of groundwater monitoring wells (existing and proposed locations) will serve as compliance wells to evaluate if indeed an impact to groundwater exists and consequential migration of contamination is occurring. RWQCB personnel pointed out that the subsurface lithology that was observed at similar sites at former MCAS El Toro indicated that groundwater flow through bedrock and alluvium was fairly consistent. Additionally, the RWQCB reiterated their typical position of not drilling through waste placement due to the potential for vertical migration of contaminants into the groundwater. A measured section of the stratigraphy of the Site will be prepared and tied to the measured section to the subsurface lithologic data gathered from the proposed wells, other borings, and excavations where bedrock was encountered. This information will be presented in the RSE Report. A local geologic map will be prepared for the site as requested and included in the RSE Report. Lithologic information from existing and proposed

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		Outcrops will be visually examined during the field investigation for the presence and trends of fractures in bedrock. Subsurface bedrock will be evaluated during drilling for the proposed monitoring wells. Leachate migration and DNAPL pooling, if relevant, will be based on the findings of the RSE, and presented in the technical memorandum. 1.1.1 GSU Response: GSU notes that the attached figure, Geologic Cross-Section A-A', while it contains some lithologic information, does not show any interpretation of the stratigraphy or structure of the bedrock of the Site. GSU suggests the following additional steps be included in the work described in the Contractor's response: 1.1.1.1 That a geologist prepare a measured section of the stratigraphy of the Site, and tie the measured section to the subsurface lithologic data gathered from the proposed wells, other borings, and excavations where bedrock was encountered. 1.1.1.2 That a local geologic map be prepared for the Site, with lithologic, strike and dip, and fracture data shown by standard notation. GSU suggests that a literature search may reveal an existing map that contains much of the required information. 1.1.1.3 That the population, orientation, and density of fractures in bedrock be characterized by standard geologic methods, and that the data be presented in standard displays including stereograms and Rose diagrams as needed. The trend of the intersections of dominant fracture sets may provide important information on subsurface fluid migration pathways.	boreholes will be used to characterize the population, orientation, and density of fractures in the bedrock as requested.

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1.	Section 4.1.2	Exposure Pathways, asserts that groundwater is considered beyond the reach of ecological receptors since it does not reach the surface at the Site or in the immediate area. This observation may be true in the short term, but the depth to water is not great, and there is considerable local relief, including the course of Agua Chinon Wash within 100 feet to the south of the Site (note Figure 2-2 Groundwater Elevation Contour Map). In addition, depth to water is about 24 feet bgs in MW-1 in the southwestern part of the Site. Changes in rainfall or irrigation patterns may bring groundwater elevations very close to the base level of the nearby wash, and allow ecological receptors to come in contact with affected groundwater. Contractor should address ecological receptors, add additional engineering controls, or provide additional documentation showing that Agua Chinon Wash will remain above the groundwater interface. 1.1 Contractor's Reply: Section 4.1.2 will be revised to indicate that groundwater is a potential exposure pathway for possible ecological receptors. If the results of the RSE indicate that contamination exists at the site, then an ecological risk assessment will be required. This risk assessment will be conducted in accordance with the BCT-approved Final Risk Assessment Work Plan (Bechtel 1995). It will include evaluation of sensitive habitat and species, site- and species-specific exposure pathways, and chemical exposure concentrations in the habitats. 1.1.1 GSU Response: GSU accepts the response, with the following note. The groundwater itself should be regarded as a receptor. It is a part of the environment, it is a resource of the State of CA, of beneficial use designation, and protected under Porter Cologne Act. If contamination exists, actions beyond an ecological risk assessment may well be required.	GSU's response noted.

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2.	Section 4.2.3	Decision Inputs, threshold level number 5. California DHS action level for perchlorate should be changes to the recently proposed action level of 4 μg/L. For more information, see the DHS web page at: http://www.dhs.ca.gov/ps/ddwem/chemicals/perchl/actionlevel.htm 2.1 Contractor's Reply: The action level has been updated to 4 μg/L. 2.1.1 GSU Response: GSU Accepts the Response.	Acknowledged.
3.	Section 4.2.7.2 of the WP and Section 5.2.5.2 of the FSP	The contractor proposes collecting 76 soil vapor samples at depths of 0-5 feet and at 8 feet, screening in the fields with a PID, and analyzing 10% of the samples in a fixed lab by EPA Method TO-14. GSU regards this proposed scope of work as inadequate for characterizing the soil vapors, and makes the following recommendations:	
3.1		The Soil Gas Survey (SGS) should be performed in accordance with California Regional Water Quality Control Board (CRWQCB), Los Angeles Region, Interim Guidance for Active Soil Gas Investigation, Well Investigation Procedures (WIP) guidelines dated February 25, 1997 or later. 3.1.1 Contractor's Reply: The soil gas survey will be performed in general accordance with the Interim Guidance. However, it should be noted Quality Assurance Project Plans and Field Sampling Plans (including Standard Operating Procedures) were developed as part of the Navy's IR/CERCLA Program and approved by the BCT. These requirements will serve as primary guidance. 3.1.1.1 GSU Response GSU has examined the Navy CLEAN Program Procedures, Volume 5, Standard Operating Procedures, Revision 77, dated 01/07/02, and finds no SOP for SVS methods, SVS QAPPs, or SVS FSPs in that volume. If these documents are available elsewhere, please provide copies for GSU	Soil gas samples will be collected at depths of 5 feet and 15 feet bgs at 38 locations (76 samples) and analyzed in a mobile laboratory for VOCs by EPA Method 8260. A description of the soil gas field sampling procedures has been added to the work plan.

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		review. If these documents have not yet been developed, GSU reiterates its original recommended methods and procedures.	
3.2		At a minimum, soil gas samples should be collected from the probes at depths of 5 and 15 feet bgs and analyzed in accordance with the CRWQCB protocols. Subsurface structure, shallow bedrock, changes in lithology and/or shallow or deep groundwater may require modification to the standard sampling depths of 5 or 15 feet. 3.2.1 Contractor's Reply: As there are no known areas of VOC contamination, a single soil gas sample will be collected at 5 feet below ground surface. If the sample has detectable concentrations of target analytes, a second sample at 15' bgs will be collected. Sampling will continue at 10' intervals if analytes are detected (§ 1.3, Interim Guidance for Active Soil Gas Investigation). 3.2.1.1 GSU Response: The referenced protocol was developed for use at commercial and industrial facilities where the source of VOC release was at the surface, and requires a rationale be provided for the number, location, and depth of sampling points (§ 1.2 Interim Guidance for Active Soil Gas Investigation). Since the subject Site is a landfill, the points of potential release may be located at any depth within the volume of waste, and the choice of a single shallow depth for sampling is not appropriate to characterize the waste. This is consistent with California Integrated Waste Management Board guidelines for monitoring landfill gas (see http://www.ciwmb.ca.gov/LEACentral/CIA/Remedial/workplan/gasform.pdf). GSU reiterates its original comment.	Soil gas samples will be collected at depths of 5 and 15 feet bgs.

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3.3		The Department of Toxic Substances Control (DTSC) Geological Services Unit (GSU) should approve of the proposed sampling locations in advance, and should be notified at least 10 business days prior to starting field activities. 3.3.1 Contractor's Reply: The Navy will provide responses to DTSC's comments on the Draft Work Plan. Following discussion with DTSC and finalization of these responses, they will be incorporated and submitted in the Final Work Plan. The Navy will notify the appropriate agencies prior to beginning field activities. 3.3.1.1 GSU Response: GSU Accepts the response.	Acknowledged.
3.4		If the probe holes are drilled or pushed in, and the rod is removed, then a sand pack should be installed to a minimum of six inches above and two inches below the soil gas sampling port. The sand pack should be appropriately sized to minimize disruption of airflow to the sampling port and to restrict the infiltration of fines. 3.4.1 Contractor's Reply: Rods will be removed only after the samples have been collected (to minimize potential ambient air intrusion). A sand pack will not be necessary. 3.4.1.1 GSU Response: GSU accepts the response.	Acknowledged.
3.5 (04/29/02)		A minimum of six-inch thick hydrated bentonite surface seal should be installed around each probe. Particular attention should be paid to probes installed in coarse soil or those that do not achieve a full five feet of penetration. The seal should be emplaced in thin layers and each layer should be hydrated for a minimum of 15 minutes prior to sampling. For additional protection, GSU staff suggest the use of a tracer gas [such as isopropyl alcohol or propane (do not use acetone)] released at the surface immediately adjacent to the probe/soil interface	*Comment modified by DTSC in June 2002 e-mail.* Response provided to modified comment.

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		and at the top of the probe to determine if ambient air has broken through and diluted the soil gas sample. The tracer gas must be added to the list of analytes reported by the laboratory. 3.5.1 Contractor's Reply: In accordance with the Guidance, a bentonite surface seal is installed only if a space develops between the probe and the formation as result of probe advancement. This is not anticipated to occur because the probe tip, probe, and probe connectors will have the same diameter to assure a good seal between the formation and the sampling assembly. A tracer gas is not currently planned for this investigation. 3.5.1.1 GSU Response: GSU reiterates its original recommendation. The use of bentonite seals and inexpensive tracer gases like isopropyl alcohol or propane are not burdensome steps, and produces a significant improvement of SVS data.	
3.5 (06/02/02)		GSU reiterated the original recommendation to use bentonite seals and a tracer gas to ensure that the sample collected is representative of soil vapor at depth. DTSC understands that the Navy does not intend to use bentonite seals or a tracer gas. According to the Navy's response to comments, "a bentonite surface seal is installed only if a space develops between the probe and the formation as a result of probe advancement." In the RTCs, please clarify how it will determined that a space has or has not developed between the probe and the formation as a result of probe advancement. Additionally, please clarify how it will be demonstrated that soil vapor samples do not contain ambient air.	The Navy will follow currently accepted industry-wide practices for probe placement and sampling. If the DTSC has published guidance that modifies or revises the procedures used, it will be considered. The Navy will follow currently accepted practices for sample analysis and data quality assessment. If the DTSC has published guidance that modifies or revises the procedures used, it will be considered. To help establish that the soil vapor sample is representative of the sampling location, the following will be performed: During purging for soil gas sampling, monitoring for fixed gases (CO_2, O_2, N_2, CH_2) will be conducted using a field detector (GA 90). If the fixed gas concentrations stabilize at concentrations below ambient conditions then an assumption that the sample is representative of subsurface conditions will be made.

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3.6		For sites where Volatile Organic Constituents (VOC's) are suspected, samples should be collected and analyzed to achieve the detection limits established in the "TO 14A" Performance Standards. A minimum of ten percent of the samples (no less than 4 samples) should attain a detection limit of approximately 10-nanograms per liter. Analytical equipment calibration should be in accordance with the CRWQCB Guidelines (either on-site or off-site analysis). These detection limits are not suitable for flux chamber analyses. 3.6.1 Contractor's Reply: The detection limits for this investigation are consistent with the overall data quality objectives. As there is no historical evidence of VOC contamination, the conclusions will be based on the soil gas data gathered in accordance with this work plan. 3.6.1.1 GSU Response: GSU reiterates its original recommendation. The use of the recommended protocol provides useful data to evaluate the performance of the sample collection methods and the field laboratory.	Method TO-14A was published by the EPA as guidance for ambient air monitoring for determination of compliance with Clean Air Act requirements to designate areas for enforcement and air pollution control regulations. As this data is used to implement regulations and controls on large areas with a significant financial impact, the requirements for the data quality are much more stringent. Soil gas measurements are being used in this investigation to evaluate the need for a soil gas collection system as part of a remedy, if required. The data is not intended for a Human Health or Ecological Risk Assessment. Consequently, the significant additional expense of TO-14A standards is not warranted.
3.7		If Methane is suspected, the analytical program should include the analysis for Methane by USEPA 8015B (Modified). 3.7.1 Contractor's Reply: Fixed gases including methane will be analyzed in the field using a GA-90. 10% of the field soil gas samples will be analyzed in a fixed-base laboratory following the modified 8015 procedure for methane. 3.7.1.1 GSU Response: GSU accepts the response.	Acknowledged.
3.8		The laboratory must maintain and comply with a Quality Assurance/Quality Control (QA/QC) plan. DTSC staff may inspect the field and/or laboratory QA/QC procedures. Copies of the QA/QC plan and laboratory calibration data must be presented to the DTSC staff	Acknowledged.

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		upon request. DTSC Hazardous Materials Laboratory (HML) staff reserve the right to audit the laboratory. 3.8.1 Contractor's Reply: The QAPP is presented in Section 6 of the Work Plan. Comment noted. 3.8.1.1 GSU Response: No further comment.	
3.9		If the soil gas analysis results will be used in a risk assessment, testing for the following soil matrix parameters should be performed in association with the soil gas survey, so the results may be used in USEPA recognized indoor air exposure models: • Soil description performed and presented in accordance with the Unified Soil Classification System (USCS). • Bulk Density • Organic carbon content of the soil (by the Walkee Black Method) • Soil Moisture • Effective Permeability • Porosity and • Grain Size distribution analysis (curve) and evaluation of fine-grained soil content (by wet sieve analysis) to determine the percent clay, silt and sand. 3.9.1 Contractor's Reply: The planned remedy for this site is a landfill cap. As no buildings are anticipated on this site, a risk assessment utilizing these models is not warranted. 3.9.1.1 GSU Response: GSU was under the impression that the decision to place a	The objective of the soil gas survey is to evaluate "hot spots" (total VOCs >300 µg/L) and the need for a soil gas collection system as part of a remedy, if required. Accordingly, soil gas analysis results will not be used in a risk analysis at this time. If exposure scenarios change, testing for these parameters will be conducted.

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		cap was not yet made, and we reiterate the comment.	
3.10		For soil gas probes that will be deeper than 20 feet bgs, the soil parameters (listed above) should be measured in each distinct lithology located beneath the site. When possible, the sampling port should be located near the lithologic interface to obtain maximum concentrations of the analyte (at the top or bottom of the interface depending upon the analyte). If distinct lithologic changes are not present , then the soil parameters should be measured at a minimum depth interval of every 10 feet from the surface to a depth of 40 feet bgs and every 20 feet bgs below a depth of 40 feet until the capillary fringe is encountered. The last soil gas sample should be collected from five feet above the capillary fringe. 3.10.1 Contractor's Reply: Please see response to previous comment. Additionally, it should be noted that the intent of the soil gas investigation is to evaluate releases from the landfill. Waste placement practices by nature usually result in a heterogeneous subsurface. With regard to sampling depths, the first soil gas sample will be collected at 5 feet and every 10 feet thereafter if soil gas concentrations exceed the reporting limit of 1 ug/l. 3.10.1.1 GSU Response: Please note GSU reply to previous comment. GSU concurs that the subsurface is likely to be heterogeneous, and suggests that deeper soil vapor sampling is an appropriate method of evaluating that heterogeneity.	Please see response to previous comment.

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4.	Figure 2-2	Groundwater Elevation Contour Map shows presumed groundwater contours for the site based on one monitoring well located up gradient of the landfill and three monitoring wells located down gradient of the landfill. Contouring the groundwater surface in monitoring wells MW1, MW3, and MW4 shows a low gradient of 0.007 (feet per foot). Contouring the groundwater surface in monitoring wells MW1, MW2, and MW4 (all located downgradient of the landfill) show an order of magnitude increase steepening of the gradient to 0.08 (feet per foot). Based on the available data, it appears that the gradient steepens near the southwestern end of the landfill [changes from an elevation of 433.35 feet (MW1) to 418.37 feet (MW2). This sudden steepening of the groundwater coincides with the deepest part of the landfill, and may indicate ponding of water. The GSU recommends further characterization of the groundwater within and immediately south-southeast of the landfill. Refer to comment 5. 4.1.1 Contractor's Reply: Placement of construction debris occurred between 1972 and 1988 and monitoring wells were installed and sampled during 1999. However, no contamination was evidenced in the monitoring wells. Continued monitoring of existing and proposed monitoring wells will allow for further characterization of contaminant concentrations and groundwater gradient directions beneath the waste placement. 4.1.1.1 GSU Response: No additional comment.	Acknowledged.
5. (04/29/02)	Section 4.2.7.6	Leachate. No direct leachate/groundwater sampling is proposed. GSU recommends the installation of two groundwater-monitoring wells within the landfill to collect leachate/groundwater samples and to allow monitoring of the leachate/groundwater surface. The contractor should target the deepest section of the fill (refer to Figure 3-1 Anomaly Area 3 – Circa 1972 Topographic low located south of the intersection of cross section lines AA3-2 and AA3-12), and the northeastern most extension of cross section lines AA3-2 and AA3-12), and the northeastern most	Comment modified by DTSC in June 2002 e-mail. Response provided to modified comment.

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		extension of the 440 foot contour interval (just north of the intersection of cross section lines AA3-6 and AA3-13). In addition to the wells located within the landfill, the GSU recommends the addition of one groundwater monitoring well near existing Vadose Zone Well PZ3 to monitor for the possible presence of leachate migrating radially from the lowest portion of the landfill. The groundwater surface appears to be in contact with the waste in the lowest part of the landfill (see Figure 3-3 Cross Sections 1, Section AA3-2-2'). El Nino weather conditions are expected in 2002/2003 and the water surface elevation could rise, increasing contact with the waste. The wells should be monitored and sampled quarterly, beginning as soon as possible to document current conditions and provide early warning of changes in groundwater elevations. 5.1 Contractor's Reply: Due to the risk of provided a conduit for downward vertical migration of any potential contamination, drilling within the estimated waste boundaries will not be conducted. Proposed wells to be located at the perimeter of the landfill will be monitored to assess any potential migration of landfill leachate. 5.1.1 GSU Response: GSU does not agree that perimeter wells will be adequate for monitoring leachate or groundwater movement within the landfill or potential migration pathways below or around the landfill. The contractor is correct that a conventionally installed well might be a conduit for vertical migration, and therefore, GSU recommends the wells be installed through conductor casing. GSU further requests that hydrographs and contamination vs. time plots be included in reports for the Site to track water elevation and contaminant concentration changes.	
5. (06/02/02)	Section 4.2.7.6	GSU specific comment 5: GSU requested that direct leachate/groundwater sampling by installing wells within the waste using a conductor casing. DTSC understands that the Navy does not	Please see response to comment #1 for drilling within the site through waste placement material.

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		intend to drill within the estimated waste boundary due to potential for providing a downward vertical conduit. DTSC continues to be concerned about the adequacy of perimeter wells to detect off-site migration of potential contaminants in the groundwater since the groundwater gradient through the site is not well understood. Additionally, since the elevation of the adjacent Agua Chinon wash is above the waste, the groundwater gradient at the site may be influenced seasonally by recharge from the wash. Please address these concerns in the RTCs. Further, the site conceptual model is based on a single water table aquifer; however, actual conditions may be more complicated. In the RTCs, please clarify how groundwater gradient will be determined. Specifically, please clarify which wells will be used to estimate the groundwater gradient in bedrock and which will be used for gradient in alluvium. Clarify how it will be determined if more than one aquifer is present. Additionally, if the gradients differ in bedrock and alluvium, please clarify how a single screened interval will provide a representative sample of groundwater. Also, please clarify how the bedrock surface at Anomaly Area 3 will be mapped and if each boring will penetrate to and identify bedrock. Since the Navy intends to install only perimeter wells during this evaluation, DTSC recommends the installation of two additional perimeter wells to obtain additional information to assist in estimating the groundwater gradient and depth to bedrock. One located adjacent to the southwest extent of the waste as close to the waste as possible, between existing wells MW1 and MW2. The second well should be located adjacent to the southeast extent of the waste as close to the waste as possible, between existing well MW1 and proposed well MW08. DTSC acknowledges that completion of the Removal Site Evaluation as discussed in the Work Plan will facilitate characterization of the site. However, DTSC still has concerns that the Removal Site Evaluation will not address the potential complexity of the site. Following review of the Technical Memorandum that will present the results of the Removal Site Evaluation, DTSC may have the same concerns and will reiterate	Hydrographs and contamination vs. time plots for the site wells will be included in future reports. The groundwater monitoring well network (as a result of existing and proposed wells) is expected to be adequate to define the gradient. Additionally, the frequency of monitoring the groundwater elevation will be increased during the wet season to evaluate any variations due to possible recharge from the adjacent Agua Chinon wash. Figures 2-9, 2-10, and 4-3 show the proposed groundwater well locations and the geologic cross-sections that were developed based on existing boreholes. MW-09 will be drilled into bedrock and will be dual screened (one in alluvium and the other in bedrock). MW-10 will be drilled and screened in bedrock. The groundwater gradient will be estimated from wells MW-09, MW-10, and MW-04 in bedrock and from wells MW-01, MW-02, and MW-09 in alluvium. Comparison of these gradients will be used to assess if more than one aquifer is present. Figure 4-3 shows the proposed locations of the two additional perimeter wells as requested; a total of 6 wells will be drilled to complement the 4 existing wells.

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		these concerns at that time, if necessary.	
6.		Groundwater infiltration is possible both within the landfill and around the landfill. Drainage and infiltration controls should be constructed to reduce the possible impact of surface infiltration 6.1 Contractor's Reply: Drainage and infiltration controls will be incorporated in the final cover system. 6.1.1 GSU Response: GSU recommends that interim drainage and infiltration controls be considered immediately, since increased rainfall is being widely predicted in the El Nino weather cycle, and the landfill may not be capped for some time.	The need for interim drainage and infiltration controls are being considered and the design and construction of such controls, if required, will be initiated upon evaluation of the RSE findings.
7.		Gross Alpha and Total Uranium concentrations in groundwater exceed the MCLs. Reportedly, a study was performed to evaluate the occurrence of naturally occurring radionuclides in groundwater, entitled "Technical Memorandum, Phase II Evaluation of Radionuclides in Groundwater at Former Landfill Sites and the EOD Range, Marine Corps Air Station, El Toro, California (Earth Tech., December 2001). The contractor should include a brief discussion in the Work Plan explaining the study findings and discussing whether of not additional sampling is necessary. 7.1 Contractor's Reply: Discussion and reference to the evaluation will be incorporated into the plan. 7.1.1 GSU Response: GSU accepts the response.	Acknowledged.

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Reviewer: Triss M. Chesney, P.E., Remedial Project Manager, Department of Toxic Substances Control, February 13, 2002

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SPECIFIC COMMENTS			
1.	Section 2.5.4	Site Characterization: Results from trench samples were compared to background and reference levels and Preliminary Remediation Goals (PRGs). Please provide the reference for these values.	The following references which are listed in Section 8 of the Work Plan are now cited in parentheses in *Section* 2.5.4: EPA 2000. Bechtel 1996
2.	Section 7.1.2	Screening PRE (Preliminary Risk Evaluation): The screening PRE states that no further action will be recommended and the risk evaluation will conclude that no further action will be recommended and the risk evaluation will conclude if the maximum detected concentrations of chemical do not exceed the residential and or industrial PRGs (USEPA, November 2000. A screening risk assessment should account for cumulative risk and hazards across media for multiple contaminants. To accomplish this, DTSC recommends that a screening risk assessment be conducted in accordance with DTSC memorandum, "Recommended Outline for Using U.S. Environmental Protection Agency Region IX Preliminary Remediation Goals in Screening Risk Assessments at Military Facilities," dated October 28, 1994.	DTSC's memorandum will be followed in conducting the screening risk assessment.

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Reviewer: Nicole Moutoux, U.S. EPA Region IX, Federal Facilities Cleanup Branch, February 7, 2002

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GENERAL COMMENTS			
1.		It is not clear based on the figures provided that the proposed monitoring wells will adequately characterize the groundwater or the hydrogeology beneath Anomaly Area 3. This is particularly important since the waste encounters groundwater and the Navy states that "the potential release of contaminants from the waste to the groundwater will be evaluated using the groundwater monitoring well network".	The groundwater elevation varies from approximately 437 feet above Mean Sea Level (MSL) at one end of the site (northeast boundaries) to approximately 418 feet above MSL at the other end (southwestern boundary), which corresponds to depths below ground surface of approximately 63 and 22 feet, respectively (Section 2.4.2 and Figure 2-2). The maximum depth of waste based on the evaluation of the pre- and post- waste placement topography was estimated to be 25-30 feet bgs (Section 3.0). While groundwater was estimated to be in close proximity to the bottom of the waste (approximately 3 to 10 feet separation), it should be noted that potential contact with waste was only noted at 1 (Figure 3-1 through 3-5) out of 10 cross-sections (approximately 10% of the lateral extent) that the site was divided into. Existing monitoring wells MW-1, MW-2, and MW-4 are located/spaced close enough to adequately characterize the groundwater/hydrogeology beneath the area of the site where the waste is expected to be in contact or close (< 5 feet) to groundwater. Wells MW-1 and MW-2 are located downgradient of the landfill. Proposed monitoring wells MW-5 and MW-6, supplemented by existing Well MW-3, were intended to characterize the groundwater/hydrogeology at the northern/eastern half of the site, where separation between waste and groundwater is estimated to be at least 7 feet. To further closely characterize the groundwater/hydrogeology at the site, the work plan has been revised to add four additional wells and also shift the currently proposed locations of MW-5 and MW-6.

Document Title:

(1) Draft Work Plan, Removal Site Evaluation, Anomaly Area 3, Marine Corps Air Station, El Toro, California

Reviewer: Nicole Moutoux, U.S. EPA Region IX, Federal Facilities Cleanup Branch, February 7, 2002

Comment No.	Section/ Page No.	Comment	Response
SPECIFIC COMMENTS			
1.	Page 4-10	Bullet number 5 under threshold levels: Please note that the new CA DHS action level for perchlorate is 4 µg/l.	The action level for perchlorate has been updated to 4 µg/L.
2.	Figure 4-3	Proposed Sampling Locations: Please provide information on which monitoring well will represent upgradient conditions.	Current depiction of groundwater gradient direction was estimated from depths to groundwater measured at existing monitoring wells MW-1 through MW-4. Based on this, MW-3 is expected to be indicative of upgradient conditions, as will proposed Well MW-6.
3.	Figure 4-3	Proposed Sampling Locations: The Navy should consider adding monitoring wells on the northeast perimeter of the anomaly area as well as on the northern side of the anomaly area.	Please refer to response to general comment #1.
4.	Figure 4-3	Proposed Sampling Locations: Please note on the legend as well as in the text on page 4-16 which samples represent sediment samples.	The exact sampling locations will be determined in the field based on surface water flow if encountered during storm events. Accordingly, the locations are not shown on Figure 4-3. The text indicates that 4 samples will be collected, 2 at upstream and 2 at downstream locations from Agua Chinon Wash. The sampling locations will be surveyed and shown on a figure in the RSE Report.